An Assessment of Health in Post-medieval Ireland: 'One Vast Lazar House Filled with Famine, Disease and Death'

by

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For Morgan

And in memory of my beloved brother John, RIP 14th Sept. 2013.
Ar dheis Dé go raibh a anam
Naomh Gobnait guidh air

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Declaration

I certify that this thesis is a result of my own research. It has not been previously submitted for a degree in this or any other university. All secondary sources of information have been acknowledged, and references to all literature used have been provided.

Signed

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Linda G. Lynch

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Date

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Abstract

Three indicators of health and diet were selected in order to examine the health status in three socio-economic groups in post-medieval Ireland. The aim was to examine the reliability of selected traditional skeletal markers of health in cemetery samples where there was a sound contextual footing in terms of the socio-economic status of the individuals. In addition, the link between socio-economic status and health was examined in order to determine if traditional linking of poor health with poverty was evident in skeletal samples. The analysis indicated that the indicators of health and diet were indeed reflective of the recorded health status of specific groups, and that health was significantly compromised in populations of low socio-economic status. Thus it indicated that status intimately influences the physical body form. Sex was also found to be a major defining factor in the response of an individual to physiological stress. Due to the highly contextualised nature of the skeletal remains, it was also evident that contemporary populations may suffer from different physiological stresses, and their responses to those stresses may differ. Adaptation is a key factor here and needs strong contextual data to be fully understood. This has implications for studies of populations from earlier periods in terms of blanket applications of interpretations. In addition, the socio-economic structure of Ireland in the eighteenth and nineteenth century was a direct result of the British policies in Ireland. The physical form of the Irish in the later post-medieval period may be seen to have occurred as a result of those policies, with the Irish poor in particular suffering substantial health problems, even in contrast to the poor of Britain. The results also show a decline in health from the medieval through to the post-medieval period, which is intimately linked with the immense social changes and all the related effects of these. This study has enriched the recorded historical narrative of this period of the recent past, and highlights that the more contextual information is available, the more nuanced narratives may emerge from the osteoarchaeological analysis. It also examines a period in Irish history that, until very recently, had been virtually untouched in terms of archaeological study.

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CHAPTER 1:
Introduction

> 'While I write this note, there is a child about five years old lying dead in the main street of Tralee opposite the windows of the principal hotel, and the remains have lain there for several hours on a few stones by the side of a footway like a dead dog' (quoted in Kinealy 2006, 173)

So wrote an unnamed visitor to the town of Tralee in Co. Kerry in 1847, or 'Black '47' as it is still popularly remembered in Ireland. It was written at the height the Great Famine, 1845-52, which saw the decimation of the poor of Ireland, with an estimated quarter of the population reduced through death and emigration. That famine had profound effects, not only in contemporary terms, but as a catalyst for change in culture, economics, and agriculture, to name but a few, in the following decades. The echoes of the Great Famine are still heard today. Its effects were so great that it overshadowed all previous disasters in Ireland, even the famine that occurred one hundred years previously and which, in reality, had a proportionally greater death toll (Ó Gráda 2012a, 651-652). This study uses archaeological human skeletal remains from the eighteenth and nineteenth centuries to document the impact of this calamity, and the previous decades of disease and famine, in different sectors of Irish society. Specifically, indicators of physiological stress (stature, dental health, and periostitis) are used to explore differences in health status in skeletal remains where archaeological contexts suggest the samples were drawn from differing socio-economic backgrounds.

The short quotation above reflects the uneven impact of the famine and raises a number of important issues in terms of the period. First to consider, in the above quotation, is the child. We do not know what she or he has died of: it may have been malnutrition, disease, or a combination of both. It may have been exposure. The child lies alone, either left there dead or to die, by its guardian, who no longer had the means, or possibly the inclination, to care for the child anymore, or the child was, like countless in the period, an orphan. We do not know if the child, again like many in the period, sought and begged for help from those around her or him. In any case, nothing helped, and the child died at the side of the street. No one has had the inclination to get the body removed. It is a typical action in times of severe stress – the normal prescribed methods of dealing with the dead are suspended. There was no traditional wake and no keening. The corpse becomes carrion to be disposed.

The writer too however, warrants further comment. He does not mention whether the child is a girl or a boy. Admittedly, it may not have been possible to tell from his vantage point. However, there is a certain lack of emotional engagement with the vista before him. Certainly, it would be foolish to impose modern morals on the past, but the popularity of the contemporary writings of the likes of Charles Dickens (1812-1870) and his horror at the conditions of the working classes in London, is testament to the fact that empathy for the poor was certainly not unknown in the period. Yet the visitor to Tralee appears detached from the scene. Despite the fact that the narrator was clearly disturbed by the presence of the corpse, the statement to a certain degree hints at a common attitude of the non-working class at the time: that the poor were something less than fully human (Marcus 1985, 146). It is not so much that the writer thinks the child deserves a decent burial, it is more suggestive that he wishes the offensive scene removed from his sight. Another important factor is that while the corpse of a five year old child lies in the main street opposite the principal hotel in the town, life goes on as normal for many of the inhabitants. The writer himself is a visitor to the town. There is no suggestion that the hotel is closed due to the famine. Life is continuing largely as normal for a section of the community, while another section of the community is dying in their hundreds of thousands of malnutrition and disease. Such evidence is repeated in coroners' reports, and from the many workhouse minute books that survive (McGoff-McCann 2003). The Great Famine, while having regional variations, was primarily socio-economic based.

Today, disease epidemics and famines have largely declined as major demographic forces (Taylor 1983, 486). The Ireland of 1845 however, was no stranger to disease and food shortages. In the eighteenth and nineteenth century Ireland was decimated by a series of famines and disease epidemics, particularly typhus and cholera. In the eighteenth century, when the Irish poor were less dependant on the potato, there was still devastation, with poor weather affecting grain harvests. However, as early as 1739 the devastatingly consequences of relying on a single crop were felt, when freezing temperatures destroyed the potatoes and, in proportion, actually resulted in more deaths than the Great Famine one hundred years later (Dickson 1995, 55; Ó Gráda 2012a). In the 30 years before the Great Famine, famine conditions were reported at least seven times (Daly 1995, 125). Food shortages were not unusual, and hunger and indeed starvation became a familiar process in pre-famine Ireland. An inadequate diet could have consequences other than just starvation. It can affect development and growth. Numerous diseases may occur as a result of dietary deficiencies, such as scurvy and rickets. Crucially, diet has an intimate relationship with infectious disease. It is a synergistic relationship: a poor diet can assist the invasion of the body by pathogens while an infectious disease may either stop a person from eating or inhibit the nutrients that would normally be absorbed. Thus the cycle continues. The availability of food in particular may be influenced by a myriad of external forces, such as economics and climate, which may significantly affect the availability, and indeed, quality of food. Today in the Western world, the primary diseases relate to degeneration and its associated problems. Infectious diseases were the primary causes of death in the past, and remain so today for countries classed as 'low-income' (WHO 2011, 124; Roberts and Manchester 1995). Until well into the twentieth century, humans had no defence against infectious disease which has claimed countless millions of lives across the globe through the millennia. Similarly, medical knowledge at the time had virtually no defence against the multitude of infectious diseases which particularly included various fevers, gastrointestinal infections, and smallpox. Although a vaccine was available for the latter by the end of the eighteenth century, it was not widely used until much later. 'At best, treatments were palliative; they were powerless in arresting the disease' (Malcolm and Jones 1999, 132).

The post-medieval period in Ireland was witness to some of the most profound changes ever recorded in Irish history. It saw the final death knell of Gaelic Ireland and the birth of the modern State. There were huge shifts in the realms of politics and economics, with significant consequences for society as a whole. By the nineteenth century Irish society had become polarised into a series of distinct socio-economic groups. The lowest ranked, and largest socio-economic group comprised a subsistence-level segment of society who existed primarily on the potato crop. Infectious disease and inadequate dietary intake converged in Ireland in the mid-nineteenth century with the apocalyptic Great Famine of 1845-52. From a population of more than eight million individuals in the mid-1840s, the population dropped by approximately 25% by the end of the famine as a result of excess mortality and emigration (Kinealy 2006, xvi). While the latter had been established as a relief valve before the famine to earlier periods of stress, the Great Famine established emigration as a reality for many born in Ireland for generations afterwards. Without it, there can be little doubt that the death toll in Ireland would have been far greater. The famine itself resulted from the obliteration of the potato crop by repeated years of blight. This had been the subsistence food for about one-third of the Irish population, and played a major role in the diets of many more (Ó Tuathaigh 1990, 203; Póirtéir 1995b, 9). Ireland's association with, and control by, Britain played a crucial and defining role, both in terms of the socio-economic composition of Ireland on the eve of the famine, and in the progress of the same.

Despite the devastating and long-lasting effects of the Great Famine there was a relative dearth of studies of the period until the 150th anniversary (Akenson 1995). Perhaps time and maturity then allowed researchers to critically begin to examine the events and consequences of the famine, with the result that there is now a considerable literature available about the period (Kennedy et al. 1999; Coogan 2012; Crawford 1997; Crowley et al. 2012a; Gray 1999; Guinnane and Ó Gráda 2000; Jordan 1998; Kinealy 2006; Kinealy 1997; Mokyr and Ó Gráda 1999; Morash and Hayes 1996; Ó Gráda 1997; Ó Gráda 2006b; Ó Gráda 2009; Ó Gráda 1999; Ó Murchadha 2011; Póirtéir 1995a). Local studies of the period have also become frequent (for example Carew 1995; Lonergan 1992; MacAtasney 1997; Mac Suibhne 1997; Ó Cathaoir 1995; O'Mahony 2005a; O'Mahony 2005b).

However, the period has been largely neglected in published osteoarchaeological studies in Ireland (exceptions include Geber and Murphy 2012; Rogers et al. 2006). This is linked to the relative lack of archaeological investigations of sites of this period up until recently. The so-called 'Celtic Tiger' years led to expansions and developments into many previously uninvestigated areas. In fact, most of the workhouse cemetery sites uncovered to date have been on account of developments and upgrades at existing modern hospitals on the sites of former workhouses. The lack of studies was also due to a perception that analysis of the recently dead can add little to the existing knowledge of that time period, given the wealth of historical data available. However, this attitude is gradually changing. In Britain it has resulted in some excellent studies, such as the analysis of the middleclass population buried at Spitalfields in London (Molleson and Cox 1993; Reeve and Adams 1993), and that of the skeletons of veterans of the British Royal Navy from the Royal Hospital at Greenwich (Boston et al. 2008), among many others. Not only can such studies add to general osteoarchaeological knowledge, they can also broaden out and elaborate on cultural and social studies of the period (Boyle 1999, 187).

The subtitle of this study is a quotation from William Carleton (1794-1869), a novelist who travelled throughout Ireland in the early nineteenth century, and was written as a description of Ireland at that time (Robins 1995, 39). It has been noted that 'particular historical occasions, such as the Protestant Reformation, or the First World War, can present crises in our understanding of death and bereavement' (Tarlow 1999, 182). Such is the case with the modern-day observer of nineteenth century Ireland. Due to the repeated epidemic diseases that swept through the country, combined with food shortages that culminated with the Great Famine, the modern observer may have a very biased view, perhaps blithely assuming that the entire country was enveloped in '…famine, disease and death' (Robins 1995, 39). In reality, this was not the case. This study will examine the 'familiar past' (Tarlow and West 1998), which is generally perceived as being well understood, when in reality there are still many preconceptions to re-evaluate. This aspect is the central theme of this study. It will be shown how skeletal remains may preserve evidence of the life-course of an individual. Given that in the eighteenth and nineteenth centuries (the period examined in the present study), the life-course of an individual was intimately linked with their socio-economic status, the health status of a skeletal population has the potential to inform on the socio-economic status of a group. Using skeletal samples from three distinct socio-economic groups in Ireland, from the eighteenth and nineteenth centuries, the aim is to assess if there are biological imprints on the skeletal remains that reflect their socio-economic status in life. The first group comprises samples of skeletons from two Poor Law Union workhouses, dating to the period of the Great Famine. These represent paupers and the most vulnerable in the community at the time. The second group comprises a selection of cemetery samples from Church of Ireland and Quaker sites. The final group comprises a large cemetery sample of mixed socio-economic backgrounds from urban Cork city, primarily dating to the nineteenth century. By comparing specific skeletal indicators of health it is surmised that a comprehensive story of health and status in late post-medieval Ireland may be accomplished.

Chapter 2 will examine the theoretical background to the study of archaeological human skeletal remains and the interpretation of pathological markers on the skeleton. It will also present the context of the present study, along with the research questions which were the foundation of the research. **Chapter 3** will give a detailed account of the general historical background to the period, setting the contextual framework for the study. **Chapter 4** presents the methodological background to the general osteoarchaeological analysis of the various sites used, as well as the specific methodologies employed for the analysis conducted for this study. That chapter also provides backgrounds to each of the sites examined, grouped into the three broad socio-economic groups of workhouse, middleclass, and urban. Site histories are provided, as well as the summarised results of the osteoarchaeological analysis. **Chapter 5** takes the evidence of final stature and femur length, to compare and contrast across the three groups, and with contemporaries in Britain and further afield. On the basis that growth is intimately linked with nutritional intake in childhood, and nutritional intake may be influenced by socio-economic status, it is hypothesised that variations should be apparent between the groups. Similarly, carious lesions and ante-mortem tooth loss (**Chapter 6**), are associated with dietary intake, which in turn again is related to the ability the person has to access various foodstuffs. The pathological markers known as periosteal lesions are examined in **Chapter 7**. This study follows the conventional interpretation of these being indicators of non-specific infection. The manifestation of the lesions and their prevalence rates are examined in the three groups in order to determine if the pattern of disease was as expected, that is generally higher and more severe in the poor, with the wealthier individuals showing less exposure. The background to each of these three markers of health, the analysis, and a discussion of the results is presented in each of those three chapters. The final chapter (**Chapter 8**), discusses the results of the previous three chapters in the context of the overall study, as well as the conclusions. That chapter is followed by the relevant appendices and the bibliography.

CHAPTER 2:
Theoretical Background: Situating the Data

2.1 Introduction

The human body is a highly complex organism. The life journey, from microscopic beginnings in the womb to the frail, aged adult dying decades later, involves a complex interplay of nature and nurture. A person is born with a body which is designed to grow, develop, and decline in a specific manner. This process however, may be highly influenced and altered by the life an individual lives, and the experiences s/he encounters. Some of these experiences, especially today, may be somewhat controlled by the individual, such as choosing, or having the right to choose, whether or not to be vaccinated against certain diseases. Other experiences may be beyond the control of an individual. Poverty, and all the associated negative factors such as compromised nutrition, poor living conditions, and inadequate medical access, is perhaps one of the most influential factors in terms of the health of an individual both in the modern Western world and in the Developing world. Natural disasters, such as extreme weather conditions, and disasters caused by the actions of humans, such as war, may profoundly change the health profile of any population, both now and in the past.

The genetic body is traditionally assigned from conception, with unique components for every individual. Today, genetic screening of embryos can allow for extensive modification of some specific traits (Avise 2004). Certain life-threatening and/or life-restricting genetic and developmental abnormalities can be assessed and targeted, ensuring that the viable foetus is free from such threats (Milunsky and Milunsky 2010). While this screening may clearly assist the human race in targeting very specific biological issues, the area does raise valid ethical and/or moral conflicts (Häyry 2010; Steinbock et al. 2009). Perhaps most importantly, genetic modification cannot solve human problems brought about by an unexpected events such as an onslaught of a new or modified disease, war, or famine to name but a few (Avise 2004, 172).

As the genetically-assigned body grows, firstly in the womb, and then in the outside world, it is inherently and strongly formed and influenced by the environment through which it passes and the experiences it encounters (Gilchrist 2000; Sofaer 2006). Genetic makeup has a certain degree of influence on how that body will react with the environment (Goodman 1991). However, living conditions (typically defined by socio-economic status) are perhaps the most influential factor on health status. Other factors include work conditions, education, and climate. Bones and teeth are highly sensitive to both changes in the norm and to inadequate levels of nutrition, as well as to the affects of chronic disease and intense physical labour (Larsen 1987). All factors are interlinked. If, during childhood years, an individual does not receive the necessary nutrition or the levels are inadequate, the growth and development of the body may be affected, and/or it can make an individual more susceptible to, for example, various disease processes. If any of the basics needed for survival - food, water, and shelter - are compromised, then the health status of an individual may be adversely affected. Conversely, in the Western world today, economic and social health advances have seen a significant decrease in the average age of menarche, while conversely the average body size has increased (Krieger and Davey Smith 2004, 99). In essences, the human body, and indeed the skeleton, is highly malleable. The dead body then is primarily defined by the world in which it lived and the life-course followed (Gilchrist 2000; Sofaer 2006).

Adaptation is one of the most crucial concepts in terms of assessing the health status of any population. Traditionally the stature of the Japanese was considered small in contrast to European stature and it was assumed to be a genetic trait. However, modern Japanese and second- and third-generation Japanese migrants to the United States are now of a similar height to their European counterparts (Hauspie et al. 1997; Tanner et al. 1982; referenced in Krieger and Davey Smith 2004, 96). While height and body size may be traditionally seen as evidence of health, neither of those physical attributes may actually be beneficial. It entirely depends on the environment in which an individual lives. The small body-size of rural populations in the Andes is heavily influenced by environmental conditions and have been interpreted as an adaptive response (Stini 1982). A tall, robust body could, in certain environments, demand too high a calorific input when life circumstances change. Darwin's 'survival of the fittest' did not, and does not, always relate to the biggest and strongest individual as may be traditionally assumed. The increase in stature in the Western world into modern times is not a case of selective breeding: rather it is a reflection of changes in the nutritional and disease profiles of populations. Adaptation in terms of health profiles must be considered within the context of the general environment. What may be healthy for one sector of society may not be so for another. Crucially also, as with all aspects of archaeology, the modern observer of the past must be acutely conscious of imposing modern views on past communities. This is especially problematic in the assessment of prehistoric populations, where there is no supporting documentary evidence. In contrast, in terms of this study, post-medieval groups in particular must be considered with often vast quantities of supporting evidence, sometimes comprising medical data. In addition, osteoarchaeologists use certain skeletal markers as indicators of health status (Roberts and Cox 2003; Steckel and Rose 2002). Yet the actual biological manifestations of these skeletal markers in the living individual may not all have been considered indicators of ill-health by the living individual.

This study examines the evidence of health from human skeletons from cemeteries dated to the post-medieval period in Ireland, and assesses the contrasts and comparisons of that health between a number of distinct socio-economic groups. This chapter proceeds firstly with an examination of the development of studies of mortuary contexts and skeletons in archaeology (**Sections 2.2** and **2.3**). It will then look at the modern perception of 'health' and how this may not necessarily translate to past populations. It will examine the concept of stress, particularly in terms of compromised health (**Section 2.4**). It will then examine how evidence of poor health may transfer to the human skeleton, and it will discuss the inherent problems and solutions in studying health in skeletal populations (**Section 2.5**). It will then detail the status of 'class' in Ireland in the post-medieval period (**Section 2.6**). This is a crucial factor in the analysis that will follow, and an important concept in the interpretation of the findings of this study. The research hypotheses is presented in **Section 2.6.1**.

2.2 The Development of Mortuary Studies

Presently, the study of human remains from archaeological contexts encompasses two basic strands (Lorentz 2008). There is the study of the physical skeletal remains themselves, which involves techniques and methodologies, and which is firmly rooted in the realm of science (see **Section 2.3** below). There is also the theoretical aspect of the interpretation of the living body itself and, of course, the context of the burial. This diverges from analytical science into the area of social science, an area that entails substantial degrees of interpretation. As such, one is a scientific biological approach to the physical remains, while the other is a philosophical and/or sociological approach to the context of the burial (ibid.). The development of the former in particular has greatly helped in the development of the latter, with the provisional of the skeletal assemblages that have been analysed using the most advanced techniques currently available. Skeletal assemblages are increasingly being assessed with specific research questions in mind.

Yet this approach to human skeletal remains is a relatively recent phenomenon. Nineteenth and early twentieth century studies of human skeletal remains were primarily concerned with the form and development of the individual and the inherent differences that could be recorded, particularly in terms of migration and especially regarding race (Armelagos and Van Gerven 2003). Cataloguing and categorising was a central process and variations between populations was the primary focus of research (Brothwell 2008). The nineteenth century was witness to a series of significant changes in many aspects of Western society, perhaps most obviously in the pursuit of scientific knowledge. In terms of the development of the study of humans, much of the debate centred around two crucial findings. Firstly was the development of evolutionary theory, most famously presented in Charles Darwin's *On the Origin of the Species* (Darwin 1859). Secondly was the founding works on genetics undertaken by the Augustinian priest Gregor Johann Mendel in the latter half of the nineteenth century (Sturtevant 1965). Both contributed greatly to the widespread debates on racial history and migration.

Race continued to form a major component of the study of the human form well into the twentieth century, but environmental factors as causative agents for change became a more commonly accepted idea. Despite the advances in evolutionary theory, or perhaps because of it, and the links with environmental influences, the descriptive cataloguing and categorizing of human remains continued virtually unabated. In essence, until the 1950s, skeletal biology was primarily concerned with analysis in terms of migration and racial studies (Sofaer 2006; Larsen 1987). Emphasis was placed on differences *between* cultures, rather than differences *within* cultures (Chapman 1987, 201). Cemetery contexts were examined using a functionalist approach: that societies functioned as an adaptation to their environments (Parker Pearson 1999, 22).

By the 1950s, archaeology was undergoing a radical change, with a move against exclusive concentration on description and migration studies (Armelagos and Van Gerven 2003). Theoretical development in the 1960s saw the advancement of 'new archaeology', and later 'processual archaeology', which began to examine the actual manner in which humans adapted to various environmental influences. This filtered through to mortuary studies also. Sherwood L. Washburn, an American anthropologist, urged a 'New Physical Anthropology', one concerned with understanding human evolution and development through interdisciplinary approaches, with a move away from exclusive cataloguing and description (Washburn 1951; Armelagos and Van Gerven 2003; Fuentes 2010; Johnson 1999).

In terms of mortuary studies, processual theory is defined by the Saxe-Binford approach (Binford 1971; Saxe 1970). It has proved a strong foundation for the study of human remains right up to the present. They saw cemeteries and their contexts as having structure, with the resulting ability to inform on structure within the community (Brown 1995, 73; Parker Pearson 1999). Mortuary analysis was particularly concerned with examining ranking and hierarchies, and the development of complex societies (Scott 1997). In contrast to previous archaeological studies of the dead, the emphasis now was increasingly on variability *within* groups (Chapman 1987, 201). However, this was always to inform on the structure of that society. It continued to emphasise that the social persona of the dead, as defined by the grave goods, was directly indicative of the social standing of that person in life (Parker Pearson 1999, 28). It did however, *begin* to emphasise, or at least acknowledge, that the treatment of the dead and the disposal of the remains were ultimately defined by the community in which that individual died (Buikstra 2006, 197). The adaptability of humans began to be acknowledged from the 1960s and also began to play an important role in the interpretation of human remains (Brothwell 2008). However, the focus remained on variability in the burial treatments, and not specifically on the 'nature of the element comprising the cemetery' (Charles 2005, 23). Essentially the focus was on *what* people did rather than *why* (Parker Pearson 1999, 32).

In the 1980s these approaches to the study of the dead were critically reviewed and broadened, with the development of what has been termed post-processual theory. This was a shift away from looking at cemeteries in terms of what they could reveal about social ranking and organisation (Goldstein 2006, 378). Some of the main proponents have been identified (Buikstra 2006, 197) as Ian Hodder, Mike Parker Pearson, Christopher Tilley, and Michael Shanks (Hodder 1982; Parker Pearson 1982; Shanks and Tilley 1982), amongst others. Cognitive approaches began to be applied to the burial record (Parker Pearson 1999, 24). In post-processual interpretations the emphasis was particularly placed on the role of the living in the formation of the funerary remains (Chapman 2003). Certainly this had been acknowledged much earlier (see above). In the late 1960s Peter Ucko, for example, observed that while wealth and status could be reflected in gravegoods (an interpretation that was typical of the time), he noted that these goods either may not make it into the grave, or may not survive (Ucko 1969). The post-processual theorists however, considerably advanced this concept of manipulation of the record by the living. There was a shift away from attributing change in cultures exclusively to external influence, and there was increased recognition of the individual in the formation of the archaeological record (Johnson 1999, 100). The works of sociologists such as Emile Durkheim, Robert Hertz, and Arnold Van Gennep (Durkheim 1965 [1912]; Hertz 1960 [1907]; Van Gennep 1960) were highly influential in the theoretical development of the mortuary studies, and particularly post-processual approaches to the archaeology of death (Buikstra 2006, 196; Chapman 1987, 201; Metcalf and Huntington 1991). Hertz and Van Gennep in particular highlighted the fact that the grave is just the final stage of a much longer and complex process. This not only would include the life lived by that person, but also the treatment and burial of the body of the person by the community. In comparison to earlier theoretical approaches where culture was the key factor, context became an increasingly vital element in interpretation.

Research became more humanist and symbolic in interpretation (Goldstein 2006, 378; for example, see Parker Pearson 1999), and the post-processual approach has sometimes been referred to as interpretative archaeology (Johnson 1999, 101). Cemeteries were recognised as 'contested events, where social roles are manipulated, acquired and discarded', and the dead, as they were in life, may be utterly misrepresented in death (Parker Pearson 1999, 32). Crucially, 'mortuary rituals and grave elaboration could… misrepresent or mask the social persona of the deceased' (Buikstra 2006, 197). The mortuary site or cemetery, was not longer seen simply as a repository for the dead (Charles 2005), but rather a construct of the host society. The dead do not bury themselves (Parker Pearson 1999, 84). It could no longer be automatically assumed that the burial was a reflection of an individual's social identity: rather the treatment and disposal of the dead body of an individual was defined by society's perception of that individual or the role that was required of that individual in death for the benefit of society (Sofaer 2006; Sofaer Derevenski 1997). Some researchers have addressed issues of tracing emotions in archaeological remains (Tarlow 1999; Tarlow 2000), though this is particularly difficult in non-literary contexts (Lorentz 2008, 277).

This change in approach to the interpretation of archaeological remains, and especially skeletal contexts, has much to owe to feminist theory in particular. The archaeology of gender is a particularly important element of post-processual theory. For decades the sex of a skeleton was unquestioningly linked to the direct assumed gender of that individual. However, studies in the later 1990s, and more recently, have highlighted the substantial complexities behind this previously assumed simplistic relationship (Gilchrist 1999; Grauer and Stuart-Macadam 1998; Pearson 1996; Sofaer Derevenski 2000). Biological sex and culturally constructed gender are not the same (Goldstein 2006; Sofaer Derevenski 1997). Now, just as it is acknowledged that the status of an individual cannot be assumed from grave wealth, so the gender of an individual in life may have no direct correlation with the biological sex of that individual (Goldstein 2006, 378).

While the processual approach may appear somewhat limited when compared with the post-processual mortuary analysis of, for example Mike Parker Pearson (Charles 2005, 15; see Parker Pearson 1999), the latter would not exist without the former. 'The archaeological study of mortuary ritual has expanded theoretically from a reconstruction of social grades based on burial accoutrements and interment facility… or of territoriality maintained through descent lines… to include a semiotic study of the messages and symbolic language encoded in mortuary customs by and for the living' (McAnany et al. 1999, 129; quoted in Ashmore and Geller 2005, 82). Increasingly also more emphasis may now be placed on everyday life experiences rather than focusing primarily on the remains of the elites in a population (Foxhall 2000). Cemetery populations are recognised as complex constructions in their own right.

2.3 Archaeological Approaches to Skeletal Remains

Just as the advances have been considerable in terms of mortuary analysis, so too has the development of actual osteoarchaeological analysis. Today, most osteoarchaeologists use a biocultural approach in their assessments of human remains (Buikstra and Beck 2006; Brickley and Ives 2008; Goldstein 2006; Larsen 1997; Lewis 2007; Roberts and Buikstra 2003). This approach emphasises the intimate links between humans and 'their larger social, cultural, and physical environments': essentially that the development of the physical body is dependant upon environmental factors as much as genetic factors (Zuckerman et al. 2012, 39). It emerged initially as bioarchaeology. That term was first used by Graham Clark, one of main proponents of 'new archaeology' in the 1960s, in relation to his extensive analysis of the organic remains, including animal bones (no human remains recovered), from the Mesolithic site of Star Carr in England (Clark 1972). The term was reused later by Jane Buikstra, specifically in relation to human remains (Buikstra 1977). However, bioarchaeology has different meanings in different countries. In Britain, bioarchaeology, or environmental archaeology, concerns any organic remains from archaeological sites. In contrast, in North America the term is reserved exclusively for human remains (Roberts 2010; Roberts 2006). In Ireland, the British terminology tends to be used in Belfast while the American understanding of the discipline informs the approaches taken in Cork. In relation to human remains, the biocultural approach represents an inter-disciplinary approach to the analysis of human remains from contextualised environments, typically with specific research questions to the fore. It has become the epitome of that post-processual desire to understand why, rather than how, skeletal remains are the way they are when they are recovered by archaeologists. This questioning relates to all aspects of the skeleton, from the birth of the individual right through until death, and to the treatment and disposal of the dead.

In the 1980s, just as general mortuary studies began to theorise more on the manner in which burial contexts were constructed by the living, so the human body itself began to be viewed as a complex construction of the experiences of life. Starting from New Archaeology in the 1960s, the human body has come to be examined on three specific levels in the archaeological world (Sofaer 2006, 17-18). Originating from an emphasis on ethnographic parallels, the actions of the living body in space and the results of those actions is a primary study. Similarly, the social aspects of the deceased and essentially, the dead body in the mortuary, is the second important strand (mortuary studies, as described earlier). Finally, the analysis of the actual osteological body, through scientific methods is the third and final facet of the study of human remains in archaeology (ibid.).

The first aspect (as with mortuary studies), relating to the actions and results of the living body, has undergone considerable analytical discourse in recent years. In this regard, the plasticity of the human body in particular is to the forefront of this concept and links in with the ideas of general adaptability that began to be considered in processual thought in the

1960s and 1970s. The body is certainly a direct result of 'unavoidable universal biological change' (Sofaer 2006, 77), which forms, grows, matures, and degenerates at a pre-ordained rate – the genetic body referred to earlier. However, the body at death may also be interpreted as a reflection of the life-course of an individual (Gilchrist 2000; Sofaer 2006; Worthman and Costello 2009). The term 'life-course' is preferable over the term 'life-cycle', as the latter implies a segmented, foci-orientated life rather than a more contextually influenced existence (Gilchrist 2000). The body, and subsequently the skeleton, may be moulded by the experiences of life (Mascie-Taylor and Bogin 2005). That life-course may be masked and/or manipulated by the actions of the living in the process of dealing with the dead (see above), but there are inherent skeletal markers that remain. The linkage of the development of the human body with its environment was fundamental to the development of skeletal studies. Sofaer succinctly describes the human body as a 'porous entity' (2006, 51), soaking up the various experiences encountered by an individuals during their life-course. Post-processual approaches to skeletal remains recognise that, as with mortuary studies of the burial context itself, the human skeleton is a construct of cultural and environmental factors and is 'contextually dependant' (Sofaer 2006, 74). The context of the human remains is the key to interpretation (Buikstra 2006; Goldstein 2006; Knudson and Stojanowski 2008).

This interpretative theoretical approach has been facilitated by advances and standardisations in scientific methodologies. New standardised techniques for the excavation of skeletons began to be developed in the 1970s (Møller-Christensen 1973). Møller-Christensen lamented the apparent widespread poor excavation techniques of archaeologists of human remains, which resulted in significant limitations in subsequent analysis, and recommended a system that meticulously revealed the skeleton, with the formation of a style of autopsy table in the field (ibid., 413). Standard methods also began to be developed, in terms of the actual recording of skeletons in the laboratory (Bass 1995; Ubelaker 1989; White and Folkens 1991). The *Standards for Data Collection from Human Skeletal Remains: Proceedings of a Seminar at the Field Museum of Natural History* (Buikstra and Ubelaker 1994) is widely used in North America, and indeed Europe, while a later British supplemental publication on standards (Brickley and McKinley 2004), is also widely consulted. The latter also addressed recent developments in terms of the chemical analysis of bone (Richards 2004). In addition, there have been a multitude of texts on the manifestation of disease on human bone (Aufderheide and Rodríguez-Martín 1998; Brickley and Ives 2008; Ortner 2003; Ortner and Putschar 1981; Rogers and Waldron 1995; Waldron

2008), as well as major international journals such as the *American Journal of Physical Anthropology* (originally founded 1918), the *International Journal of Osteoarchaeology* (founded 1991), and the *International Journal of Paleopathology* (founded 2011). All have either facilitated the development of osteoarchaeology or have occurred directly as a result of advances in that discipline.

The study of the health status of past populations is one of the most commonly addressed issues in osteoarchaeology. It forms the central premise in the present study. The perception of 'health' will now be examined, specifically in relation to how it may be applied in past populations.

2.4 Perceptions of 'Health'

Health, or perhaps more accurately, the skeletal evidence of ill-health, is a key component of many osteoarchaeological studies (Cohen and Armelagos 1984; Roberts and Cox 2003; Steckel and Rose 2002). But what is 'health'? The modern interpretation of health is likely to be different to that understood by an individual living in, for example, the Iron Age. Indeed, the notion of heath may differ within a single society, depending particularly on socio-economic status and access to medical care. The right to physical health, and ultimately to adequate medical care, is a very modern concept (O'Gorman 1998). It simply could not have existed in any pre-modern world, without the present advanced living conditions and medical care. Therefore it is difficult to assess what 'health' may have meant to a distant population who simply did not have the same standard of living that many in the Western world have today. At the most basic level this includes adequate accommodation including clean water and good sewerage and waste disposal, standard medical and dental care, and adequate food intake. Good health is also quite subjective. Just as individual responses to actual pain varies (Bendelow and Williams 1995), so too do individual interpretations of health. It is intimately linked with the medical care that may or may not be available. If there is no medical cure for a condition then an individual in the past may essentially have 'put up with' far higher levels of discomfort and/or pain than an individual in modern society with access to what are now considered basic over-the-counter medicines such as painkillers (particularly paracetamol and ibruprofen), amongst others. The acknowledgment of the detriment of imposing modern views on the distant, or even not so distant, past is a fundamental factor in archaeological interpretation. Studies warn against imposing modern views on, for example, interpretations of disability in past societies (Dettwyler 1991; Roberts 2000a). With the absence of modern medicine the only medical options available are alternative medicines, such as acupuncture and homeopathy, amongst others. Empirical data indicates that alternative medicines are generally not as successful at combating most health issues as modern medicine, although some are undoubtedly highly beneficial (Schneiderman 2000). The two branches are increasingly being used in conjunction with one another however.

Today, as undoubtedly in the past, health means different things to different individuals. The official definition of health by the World Health Organisation is that it is 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (WHO 1948). This definition has been in force since 1948. In reality, the definition is unattainable even in the most affluent of societies. It is the use of the term 'complete' that hinders the actual practical application of the definition, for what individual or society can claim a state of complete physical, mental, and social well-being at all times? Even should the word 'complete' be excluded, most modern Western societies or communities would strive to achieve top marks in all realms. Many of the wealthiest nations in the modern world are suffering as a result of dramatic increases in cardiovascular disease and obesity directly related to lifestyle, suffering increasingly from the diseases of civilisation and affluence (Bray et al. 2004; Eaton and Eaton 1999; Strassmann and Dunbar 1999). In modern times affluence and advanced medicine cannot ensure physical heath. This is particularly due to the fact that today especially an individual may have significant choice in the life-style lived and the diet consumed. Similarly, mental and social health is unlikely to be at peak levels at all times. In essence, WHO's definition of health is unattainable for all individuals in every society across the globe. The Oxford English Dictionary's definition of health as 'being free from illness or injury' (www.oxforddictionaries.com), is perhaps closer to the general perception most people would have about the concept of health. Health includes issues associated with, for example, under- or malnutrition, infectious disease, degenerative diseases associated with occupation, traumatic assaults, amongst others. In effect, these conditions are as a result of living life and the experiences, both decided individually and forced on a person by other agencies, that a person may encounter. Health is not simply to be free of disease.

The ancient Greeks recognised the link between environmental conditions and disease and well-being (Tountas 2009). The medieval concept of the body was based on the Greek tradition that the body, just like the four elements of the universe, depended for its existence on four 'humours' that were created from the digestion of food (Rawcliffe 1995, 33). The humours included yellow bile, phlegm, black bile, and blood. Health was achieved when the four were harmonious, although it was acknowledged that heredity, age, and circumstances could make one humour more pronounced that the others. This latter imbalance formed the personality of the person (ibid.). This concept of the body essentially prevailed until the nineteenth century and the advent of modern scientific investigations. Until then, imbalances in the elements of the bodies, which resulted in sickness, had to be counteracted. Methods included phlebotomy or blood-letting, and cupping, which aimed to control blood flow. The actual spread of disease was linked with bad air or miasma (Robins 1995). The advent of modern medicine, in particular in terms of understanding the human body, and how nutrition, disease, and working conditions to name but a few, affect the body and could be possibly either controlled or eradicated, brought a fundamental shift in how people interpreted health.

Crucial also to the modern concept of health was the continuing and expanding notion of a social consciousness in the nineteenth century. While much of the philanthropist's drive may have originated from a religious responsibility or zeal (Moffitt 2008), genuine philanthropic desires to improve the conditions of the poor were also prevalent. For example, the seminal work of Sir Edwin Chadwick (Chadwick 1843), while being instrumental in setting up the infamous Poor Law Union Workhouse system in Britain and Ireland, painted a detailed and unrelenting picture of the conditions of the poor in that period. Thousands of copies of the report were distributed in a deliberate attempt to get the information out to people on the importance of hygiene and sanitation (Mokyr 1993, 327). Some of the advances in health, particularly in terms of working conditions, and to a lesser extent living conditions, have been linked with cold economic sense: poor working conditions in the vast Victorian industrial factories and mines had impacts on the workers which ultimately had impacts on profits (Wohl 1983). It was also part of an overall 'ethic of improvement', a certain degree of a 'duty of care' to the less well off to better themselves (Tarlow 2007).

However, even with the best of intentions, society before the nineteenth century was simply not equipped or ready for radical changes in dealing with defects in the realms of medicine, education, living conditions, and working conditions, amongst others. Even when significant changes began in the nineteenth century, social reform very much took the form of 'trial and error' (Wohl 1983). For example, the new sewerage systems in nineteenth century London greatly helped with the reduction of disease but the problems of dumping enormous quantities of untreated waste directly into rivers only became apparent much later (ibid., 233). Initially also there was staunch opposition to inoculation, and later to vaccination, against one of the main killers in the human record: smallpox. People were understandably suspicious of those that claimed that disease was spread by so-called microscopic organisms that were invisible to the naked eye. Still today modern medicine is, quite rightly, open to questions. In the late 1990s, a hypothesised link between the MMR (measles, mumps, and rubella) vaccine and autism, led to a genuine public fear, which in turn lead to a significant drop in the levels of vaccination against these serious diseases (Burgess et al. 2006).

It has also been argued that the final acceptance of germ theory allowed specific pathogens to be concentrated on, but hindered the development of widespread social reforms (Krieger and Davey Smith 2004, 93). The final acceptance of Darwin's theory of evolution could be seen to have somewhat hindered social reform. The premise of 'survival of the fittest' was used to suggest that the poor were poor through their own fault, and that they lacked the basic functions of betterment (ibid.; Spencer-Wood and Baugher 2001, 6). This somewhat contradicts the 'ethic of improvement' mentioned earlier, but it in fact relates to the poor who could not, or did not, contribute to society in terms of actual labour. This would particularly include individuals such as paupers and the disabled. Eventually, improvements led to a decrease in infant mortality, an increase in longevity, and a general increase in quality of life for most citizens, trends which have continued to the present day.

It is perhaps relatively easy for individuals living in a modern western country to overlook the advances that have been made in recent years and how our perception of health has correspondingly changed. As recently as 1955 the global life expectancy was just 46.5 years (WHO 2003, 3). By 2009 it had risen to 72 years (WHO 2012, 60). However, the improvements have certainly not been universal. Today, a girl born in Japan has a life expectancy of 86 years (WHO 2012, 54). In contrast, a girl born in Sierra Leone has a life expectancy of 50 years (WHO 2012, 58). Today, people are aware, at least on a superficial level, of the considerable and continuous advances in medical research in the twentieth and twenty-first centuries in particular. The progress in the realm of disease prevention has been considerable, specifically in the form of a multitude of vaccinations against diseases such as smallpox, poliomyelitis, and measles, although vaccines for many other diseases have yet to be developed. Considerable advances have also been made in terms of combating the severity of other diseases for which there is not yet a cure, such as HIV and cancers. General care of the individual, be it in the General Practitioners office or in a hospital environment, is unrecognisable from the medical care that was prevalent for most of the post-medieval period, when the primary aim was to alleviate pain and suffering as much as possible rather than to prevent it (Malcolm and Jones 1999, 132). Indeed, an individual in a modern advanced society, after centuries of considerable advances in medicine essentially believes that they have the *right* to medical care and ultimately to a cure. This is likely to be part of the reason why modern Western society seems to find it difficult to deal with death, or at least to understand why death has taken place despite all of the medical advances. Death has become 'medicalised, professionalised, and sanitised…' (Debate of the Age Health and Care Study Group 1999; quoted in Smith 2000, 129; O'Gorman 1998). In the past, if there was no cure for a disease, then individuals may have been considerably more tolerant of pain and other physical processes than individuals living today with access to modern medicine. Today, even if physical ill-health is largely brought on by an individual, for example by smoking or by consumption of a highly-processed diet, that individual, to a certain degree, may expect modern medicine to be able to counteract the effects. Unfortunately, the primary causes of death in the Western world, as mentioned above, would confirm this is not always possible. Health is also now more often being viewed in a more holistic manner. Modern medicine can sometimes perform miracles but there is an increasing realisation that the mind of a person is intimately linked with their well-being, mentally as well as physically.

2.4.1 Stress and Adaptability

It is notoriously difficult to identify specific diseases in archaeological skeletons (Aufderheide and Rodríguez-Martín 1998; Ortner 2003; Roberts and Manchester 1995). Only a select number of diseases will present with lesions to the skeleton, and these may not always be identifiable to a specific disease. Exceptions include the distinct 'sucked candy' appearance of the digits of the hands and feet in advanced leprosy, and the caries sicca lesions in the cranium associated with tertiary syphilis. While epidemiology is a vital aspect of the study of human remains – as it is pertinent to the modern study of disease (for example see Roberts and Buikstra 2003) – it is from the study of general stress in the human skeleton that much of the osteoarchaeological information is derived. Physiological stress is a broad-ranging term. It is a general phrase covering cumulative data on the (in the case of human skeletons) physical stress an individual endures. Physiological stress is a product of a combination of factors. These include environmental constraints, cultural buffering systems, and host resistant factors (Goodman et al. 1984, 14). The standard skeletal traits that are taken as being indicative of stress and ill-health are examined below in **Section 2.5**.

'Humans are born with hereditary raw materials but what is made of these genetic characteristics largely depends on environmental factors' (Tountas 2009, 191). 'Stress' in human skeletal remains is measured along two parameters. Firstly, the growth and development of the human body is highly sensitive to fluctuations in nutrition and diet, which can affect both the form and size of both bones and teeth (Larsen 1987). Secondly, the life-course that an individual follows may highly determine the body-form that an individual develops and particularly the diseases and assaults to which that body may be exposed. It is how the body moulds itself to its life experience that is the fundamental foundation of the interpretation of health. The malleable and adaptable body is moulded, for better or worse, by a life lived (Sofaer 2006).

It is how the body (and eventually the skeleton) adapts to stress that is the crucial factor in the study of health in past populations. Perhaps the most widely applied theory of stress is that of Hans Selye (1907-1982), the Austrian-Hungarian endocrinologist. His theory of stress, General Adaptation Syndrome or GAS, identified three levels of coping with stress: adaptive coping, which allows the stress to be resolved; maladaptive coping, which causes further problems; and active coping, which is actively seeking to resolve the stress. The maladaptive coping strategy is clearly the least desirable. Critically too, 'the same stimulus will act differently in different individuals' as a result of endogenous (such as genetic predisposition, age, sex) and exogenous (such as environmental) factors (Selye 1976a, 54). It is the adaptation of the individual to the physiological insults that is the key to the interpretation of health. For example, some would argue that a diminished stature is an adaptive method, that allows an individual to deal with the compromised environment of poor nutrition in which they grew up (Seckler 1980; Wolański and Siniarska 2001). Essentially, a small body size has lower calorific demands, and can deal with periodic calorific decreases quite readily. While this is a logical interpretation, this has been classed as a 'maladaption' by others (Goodman 1994, 312; Larsen 1997, 62), with possible consequences at least including a decrease in life expectancy. This concept of maladaptation has long been recognised in studies of biological stress in the living (Selye and Fortier 1950; Selye 1976b).

2.5 Health in Skeletal Remains

As stated above, the study of health in past populations is one of the cornerstones of bioarchaeology. In general, osteoarchaeological studies have established that there have been declines in human health associated with specific developments. In particular, numerous studies have shown decline in health with the adoption of agriculture (Cohen 1989; Cohen and Armelagos 1984; Larsen 1987), as well as with the development of complex societies and/or the onset of industrialisation (Lewis 2002; Mays et al. 2008). However, these declines were certainly not universal. For example, skeletal samples from Mesoamerica and Sudanese Nubia in the Nile Valley are somewhat conspicuous in the lack of an increase in infectious disease with the shift to agriculture and the increase in population (Larsen 1997, 89). In addition, it is unlikely that, even when there were overall declines in health, that the process was a uniform one. Populations are not static and no population follows a set route of increasing complexity and development with associated lowering of health status. Economic historians detailed use of stature, from, for example military, naval, and prison records, confirm just how sensitive the human condition is to change (see **Sections 5.4** and **5.5**). For example, it has been shown that the final statures of individuals born in the United Kingdom in decades of social and/or economic strife in the eighteenth and nineteenth centuries were lower than individuals born in decades of relative peace and prosperity (for example see Komlos 1993b).

These nuances cannot typically be determined from archaeological cemetery populations. This is primarily due to the length of use-period of the site, which may be considerable. In addition, archaeological excavations are, by their nature, limited in the amount of material excavated. Indeed, the cemetery sample itself is biased. As discussed earlier, a cemetery is a construct of the living community and, as such, they decide who gets buried where. Thus while general health trends over periods of times, such as the change from hunter-gatherer to agriculture referred to above, may be assessed, it is typically not possible from archaeological skeletons to assess changes in health status over, for example, a single century, due to inherent biases in the archaeological record. However, archaeological studies can sometimes assess differences in health *between* different sections of society, if the appropriate material is available. This is one of the primary aims of post-processual theory – to look at why differences are apparent and not just what those differences are. 'Appropriate' refers to a cemetery sample that comprises adequate numbers of individuals with good levels of preservation, from a cemetery with a limited period of use and relating to a specific class of society. Thus the middleclass skeletons recovered from Spitalfields in London (Molleson and Cox 1993) provided a wealth of information about that post-medieval group, as did the sailors from the Elizabethan ship the Mary Rose (Stirland 2000), and the soldiers from the 1461 Battle of Towton (Fiorato et al. 2000), amongst many others.

In terms of archaeological skeletons the assessment of health is obviously limited to evidence that actually involves the physical skeleton. Defects and/or injuries to soft tissue and mental health can never be assessed. Occasionally, there are diseases, congenital deformations, or traumatic assaults that can leave distinct traces on the bone that would have caused visible and significant physical deformities (Hawkey 1998; Kilgore and Van Gerven 2010; Murphy 2000; Stirland 1997; Trinkaus and Zimmerman 1982). As mentioned above however (**Section 2.4.1**), more general evidence of stress and ill-health in skeletons may reveal a wealth of information regarding past populations. There are a number of, quite often subtle, features that can manifest on the bones and teeth that can be used to infer the health of an individual.

The skeletal stress indicators may be classed into three broad groups: indicators of general cumulative stress; indicators of general episodic stress; and indicators of stress associated with specific disease (Goodman et al. 1984, 14-15). The first may be assessed using mortality measures and growth assessments, the second through pathological lesions such as Harris lines and dental enamel hypoplasia, while the third specifically refers to infectious diseases and porotic hyperostosis (Goodman et al. 1984, 16-29). Overall, the pathological indicators of general deprivation in particular may be the most revealing. They have been termed the 'memories of youth' (Larsen 1987, 357). In particular these include growth studies, such as long bone length and thickness, developmental defects such as Harris lines and enamel hypoplastic defects, and pathological lesions such as cribra orbitalia and porotic hyperostosis. These do not refer to specific diseases but to undetermined episodes of physiological stress. The interpretation of these markers in archaeological assemblages has long been used as a mechanism for assessing the health profiles of past populations, particularly in prehistoric contexts (Cohen and Armelagos 1984; Cohen 1989; Larsen 1995; Otero and Novellino 2011; Steckel and Rose 2002).

Increasingly, these recognised primary skeletal indicators of health have been standardised, perhaps most obviously in the impressive Global History of Health Project (www.global.sbs.ohio-state.edu/global.php). Both the North American strand of the study (Steckel and Rose 2002) and the studies currently underway in Europe (Steckel 2003) utilise a specific set of pathological lesions of the skeleton to assess the health status of a population, as well as looking at dental disease (dental caries, abscesses, and enamel hypoplastic defects) and stature. Other avenues of study include cribra orbitalia and porotic hyperostosis, infections, degenerative joint disease, and trauma (Steckel et al. 2002, 69). The latter two are indicators of the general stresses and strains and individual may encounter throughout their life, while the others may be taken as an indication of the disease load on an individual. Dental assessments relate specifically to diet, while stature is an indicator of nutritional intake in childhood. The present study looks specifically at stature, dental remains (carious lesions and ante-mortem tooth loss), and non-specific infections (see **Section 2.6.1**).

2.5.1 Inherent Problems and Solutions to Assessing Health in Skeletal Remains

There are inherent problems with using human skeletons to assess and inform on past societies. Traditional osteoarchaeological thinking surmised that, by looking at skeletal assemblages and the pathological imprints on the bones, one could assess the health profile of that population. If the prevalence of, for example, infection was high in a population, then it could be surmised that the population had a high disease load. Conversely, cemetery population with a low prevalence of infection could be deemed to be relatively healthy. By comparing data from populations over time, and perhaps space, one could speculate about the development and movement of both diseases and populations. However, there are a considerable number of inherent biases within this process.

Archaeological skeletal samples, by their very nature, are highly biased. The cemetery presents the typical archaeological dilemma: 'a short use-life minimises the potential for diachronic change, but may provide an insufficient sample for meaningful analysis, whereas the large cemetery, ideal for social analysis, often has the greatest potential for diachronic distortion' (O'Shea 1984, 14; quoted in Chapman 2005, 26). Most cemeteries, and the skeletons excavated from them, represent aggregations of samples of populations, and multiple generations (Larsen 2006, 361). The cemeteries themselves are typically complex constructions of the living community and may, for example, exclude certain individuals such as children (Murphy 2008; Murphy 2011). The process of excavation itself is highly biased: for example, entire cemeteries are rarely excavated. Differential levels of preservation also play an important role in the level of assessment possible of the skeletal remains. Similarly, the methods used during the excavation, the experience of the team, and post-excavation issues such as processing of the bones and storage, amongst other issues, all play a role in the skeletal remains available for analysis. As was noted earlier (**Section 2.3**), methods used in the analysis of human remains have been largely standardised (and are frequently reviewed), which aids significantly in the reliability of the analysis.

One of the basic hypotheses of osteoarchaeological study is that the health status of a population may be deduced by looking at certain recognised skeletal indicators of stress. Most studies, until recently, were of prehistoric material, particularly relating to the origins of agriculture (Cohen and Armelagos 1984; Cohen 1989; Larsen 1987). These studies convincingly argued that, once a group adapted to an agricultural system, as opposed to a hunter-gatherer system, the overall health profile of the group diminished. In numerous populations, on various continents, it appeared there was conclusive evidence that stature decreased, dental diseases increased, and the overall level of pathological diseases and insults increased from the hunter-gatherer group into the agricultural group. This appeared entirely logical. With agriculture came a decrease in mobility on one level with people staying on the land, but an increase in contact on another, with a rise in population, and the eventual development of substantial trade networks. The numbers of people living together increased, which had implications for the spread of disease in particular. Crucially also it appears that the nutritional quality of diet decreased substantially. The move from a hunter-gatherer lifestyle to agriculture was apparently to the detriment of human health.

However, the problem is in the assumption that what the osteoarchaeologist sees as the skeletal indicator of stress equals poor health. This problem, along with others, was particularly addressed in the seminal 1992 paper entitled '*The Osteological Paradox'* (Wood et al. 1992). The issues that the paper addressed were essentially logical biases that could occur in archaeological assemblages, which are ironically somewhat contradictory to traditional interpretations of human skeletal remains. Wood *et al* (1992) surmised that a basic supposition behind skeletal studies was inherently flawed. The dead in the cemetery could never be representative of the living population because they were imbued with inherent biases. They targeted three particular conceptual problems: firstly, demographic non-stationarity; secondly, selective mortality; thirdly, hidden heterogeneity in risks (*ibid*.). They particularly concentrated the issues on prehistoric populations. At that time, very little work had been undertaken on historic skeletal assemblages.

Demographic non-stationarity relates to the fact that no population is static and unchanging, and that even small changes to fertility rates can have significant impacts on age-at-death distributions, rather than mortality. Thus the demographic tools such as life expectancy statistics may not be accurate (Wood et al. 1992, 344). The concept of selective mortality is a central factor in terms of assessing the real potential of skeletal analysis. Archaeological skeletal assemblages are biased by the very fact that they represent those who died and not those who lived and survived until an advanced age. Those in the cemeteries are the 'non-survivors' (ibid., 349). An individual in a cemetery cannot be taken as representing other living individuals in that society because of the very fact that s/he died to begin with. Those buried in cemeteries essentially represent the weakest and most vulnerable of each section of society. The hidden heterogeneity in risks is an important concept to observe as it recognises the fact that individuals will vary in their susceptibility to disease and death. Some will not be affected at all by a disease, others may succumb quickly, others may recover. This translates to osteoarchaeological studies to mean that, critically, those who died from a disease may have no osteological markers of that disease and, somewhat ironically, those with skeletal evidence of disease may actually be the individuals healthy enough to survive. This relates back to Seyle's theory of stress (see **Section 2.4.1**), and the concept of adaptive coping, maladaptive coping, and active coping (Selye 1976a, 54). Even those that show traces of stress from childhood, such as enamel hypoplastic defects, may again reflect individuals who were able to survive the insult. As such, the healthy may retain the indicators of stress, the unhealthy would die. Given these valid points, how can any osteoarchaeological assemblage be taken as representing a living population?

Mark Cohen, one of the main supporters of the deduction that health declined with the advent of agriculture (and therefore that skeletal markers of stress were indeed indicative of health status) published a reply to the issues raised in the *Osteological Paradox*, which essentially reiterated his and George Armelagos's earlier findings (Cohen 1994). The 'implicit assumption' was that 'skeletons in a cemetery…are reasonably representative of the living populations that produced them and therefore that changes in skeletal assemblages reflect real changes in the health of once-living populations' (ibid., 629). However, in reality, the hypotheses of Cohen and Armelagos could never be conclusively proved due to the sheer antiquity of the skeletal remains, and the inherent problems that occur with archaeological cemeteries (see above). While the deductions of Cohen and Armelagos were logical, they were not indisputable, and contrary arguments could be legitimately raised. Essentially, were stress markers indicative of an increased ability to withstand stress, the paradoxical approach, or were they indicative of actual increased levels of stress, the normative approach (Jackes 1993, 434; Wright and Yoder 2003, 57)?

The key to addressing the issues raised by the *Osteological Paradox* was to apply specific research questions towards documented populations, and to recognise that heterogeneity was the quintessential element of bioarchaeological research: no population is static (Wright and Yoder 2003, 46). Contextual information was crucial, which was the ultimate foundation stone of post-processual theory (Goldstein 2006; Knudson and Stojanowski 2008). Using 'discrete populations' enabled the assessment of just how representative skeletal populations were, and are, when it is already known what stresses they were under (Knudson and Stojanowski 2008, 414). Numerous studies have been undertaken using this highly contextualised approach. A comparative study of children from a medieval leprosarium and children from a more privileged contemporary group in Denmark confirm the traditional interpretation of skeletal stress indicators (Bennike et al. 2005). Šlaus (2008) saw a marked increase in skeletal stressors in his Croation population dating from a period of intense cultural, social, economic, and political change, marked by considerable social stresses including famine, disease, and depopulation. In her excellent study of anaemia in medieval York, Sullivan (2005), while acknowledging the originality and merits of the hypotheses of Wood *et al* (1992), argued that the traditional interpretations of skeletal indicators of disease and ill-health may be favourable when all of the available biological and socio-economic data would compliment them.

The increased interpretative nature of some of the skeletal studies conform with Littleton's plea for the production of 'local biologies' (Littleton 2007). Historical data can be utilised, along with contextualised human skeletal remains, to test various hypotheses (Lambert 2006, 107). In both Britain and the United States there are a wealth of excellent interdisciplinary skeletal biographies. In Britain these include, but are certainly not limited to, the study of a mass grave associated with the fifteenth century Battle of Townton (Fiorato et al. 2000), the analysis of post-medieval skeletons from Spitalfields in London (Molleson and Cox 1993; Reeve and Adams 1993), the drowned sailors and soldiers onboard King Henry VIII's flagship, the Mary Rose (Stirland 2000), and veterans of the British Royal Navy (Boston et al. 2008). In the United States, and further afield, a wide variety of contextually-sound skeletal assemblages have been examined. These include individuals who were slaves on plantations in Barbados (Shuler 2011), North Carolina (Lambert 2006), Jamaica (Armstrong and Fleischman 2003), and Suriname (Okumura 2011), a post-slavery cemetery from Cedar Grove in Arkansas (Rose 1989), mineworkers in South Africa (Van der Merwe et al. 2010a; Van der Merwe et al. 2010b; Van der Merwe et al. 2010c), and Dunning poorhouse in Chicago (Grauer et al. 1998). These studies aim to build biocultural images of the past, using a wide range of information, including the skeletal remains (Grauer 1995). In some cases, the data are being co-ordinated into very broad ranging studies. Thus there is the Global History of Health Project, with work complete on 12,520 in the western hemisphere (Steckel and Rose 2002), and work on-going on the European module (Steckel 2003). A recent British study collated the data from over 34,000 individuals to build up a revealing picture of health and disease through the millennia, from prehistoric times until the present day (Roberts and Cox 2003). Overall, most acknowledge that while high prevalences of indicators of ill-health clearly indicate that a population were under stress, it also conversely indicates that, at least to a certain degree, the population had built up at least some immunity to these stresses.

2.6 Context of Present Study

Human skeletal remains can reveal detailed information on the life-course of an individual. When there is adequate contextual data, and a comprehensive research agenda, this may be applied to wider population groups or samples. The health status of past populations is one of the most frequent areas of investigation. While caution must be applied in the interpretation of the markers of ill-health, when the information is combined with detailed contextual data then the past may begin to reveal itself. Sometimes the revelations may be in contradiction to traditional records of the past. If this is the case, then the reasons for such discrepancies must be explicitly explored.

As noted in **Chapter 1**, the words of Irish writer William Carleton (1794-1869) provide the sub-title of this study. A 'vast lazar house' is a common perception of nineteenth century Ireland, particularly the period of the devastating Great Famine of 1845-1852 (see **Section 3.4**). But to what extent was is Carleton's statement a reflection of fact? The human skeletal remains of the people of this period hold the key to an in-depth understanding of the effects of people's circumstances on their physical bodies.

2.6.1 Research Questions

Based on the explicit theorisation of health in this chapter, this study is based around two specific hypotheses. Firstly, that traditionally recognised skeletal markers of stress are precisely that: the presence of the markers may be seen to be reflective of the health status of a population sample. Studies have indicated that populations that are known to be under physiological stress will have the evidence of that stress preserved in the bones and teeth. However, the interpretation of these markers must be undertaken with caution. As such, the questions raised by the osteological paradox (see **Section 2.5.1**) were constantly considered in the interpretation of the results of the analysis.

Secondly, based on previous studies, there is an established link between socio-economic status and health, and that, invariably, the poorer an individual is, the more exposed to physiological stress they are. In the past, that stress often related to problems of inadequate food supply, either in terms of quality or simply the lack of same, and also to disease and parasite infestation. Nutrition and disease have a synergistic relationship, where a disease may hinder the absorption of nutrients from food, which can further affect an individual, or a malnourished individual may be more susceptible to disease. Studies have shown that, in general, those in lower socio-economic groups will tend to be poor, with little education, and with inadequate living conditions and access to medical services, if indeed the latter are even available. In contrast, wealthier individuals are typically healthier and have higher life expectancy than their poorer contemporaries (Lupien et al. 2001; Smith 1990; Valkonen 2001).

Using these basic hypotheses, the post-medieval period in Ireland was chosen as the period of study, due to the degree of contextualisation of many burial grounds, where specific graveyards may be linked with specific socio-economic groups. In historic populations, distinct social groups may be more readily identifiable due to the written sources available, and assessing health differences between contemporaries is often more achievable than in most prehistoric contexts. Indeed, in contrast to prehistoric populations, where high status individuals may be more apparent in the archaeological record, it could be argued that in the post-medieval period in particular, lower socio-economic groups become more visible in the records, often being confined to distinct cemeteries. The latter includes cemeteries associated with slaves, workhouses, and prisons, for example. Three Irish post-medieval groups were chosen for the present study: a low socio-economic group from the nineteenth century Poor Law Union Workhouses (**Section 4.3**); a middleclass group comprising a number of Protestant (Church of Ireland and Quaker) cemeteries (**Section 4.4**); and a single large mixed urban population from Cork city (**Section 4.5**). It is proposed that clear tangible differences should be apparent in the manifestations of health between the three socio-economic groups, or at least between the workhouse group and the middleclass group, given that these groups were very different in socio-economic status. It may be expected that the poor would reveal a compromised health status, while the better-off would have evidence of their affluence preserved in the bones. The workhouse groups in particular comprised primarily paupers (as described in **Section 2.6.3**) and form perhaps the most distinct group of the three. If there are differences in the health statuses of the three groups, then 'class' and socio-economic status (**Section 2.6.2**) may be seen to structure the physical biographies of people.

Three skeletal indicators of health were chosen in order to assess the health status of the three groups. Stature was examined (**Chapter 5**) on the basis that final stature is a general indication of nutrition in childhood, with the premise being that a reduced stature is indicative of deprivation. Stature should therefore be related to socio-economic status. Prevalence rates of both carious lesions and ante-mortem tooth loss in the dentition were examined (**Chapter 6**) on two basic premises. Given historical evidence, particularly on the advances in food production and the increase in sugar in the post-medieval period, dental diseases should be quite prevalent. Related to this, it was surmised that variations should be evident between the socio-economic groups on the basis that diet in this period was greatly influenced by socio-economic status Finally, non-specific infections (**Chapter 7**) were examined on the premise that higher prevalence rates would be expected in the lower socio-economic groups where living conditions may have been compromised. Each of these is examined in detail in the relevant chapters.

It is proposed that the results of the analysis will then be considered within the context of traditional interpretations of the period. For example, there can be little doubt that the poor in nineteenth century Ireland were under significant stresses, while those at least living above subsistence level were less exposed to such stresses. Was this apparent in the current results? If not, why not? Also under consideration will be the influence of sex on the health status of groups. Are there differences between the female and the male experience in terms of physiological stress?

In addition, from 1801 and the Acts of Union, Ireland was legally an integral part of the United Kingdom. At first glance, the poor in Ireland were treated, and legislated for, in a similar manner to the poor of Britain. Was this in fact the case and, in terms of skeletal remains, did the poor, middleclass, and urban individuals in Ireland differ from their counterparts in Britain? Crucial in this respect is how intimately Ireland was bound with the British Empire at the time. The variations in socio-economic groups in Ireland in the latter part of the post-medieval period (the eighteenth and nineteenth centuries in particular), were as a direct result of British policy in Ireland. Did this have a biological imprint on the health of the people of Ireland?

The remaining section of this chapter will firstly look at the structure of society in Ireland in the latter stages of the post-medieval period. Specific emphasis is placed on the poor, given that this is the most distinct group within the present study in the form of the workhouse group. The perceptions of the Irish, and especially the poor, will be examined, with a particular reference to paupers, those who were admitted to the workhouses.

2.6.2 'Class' in Post-medieval Ireland

The modern observer must be particularly careful of attempting to apply today's concepts of class – typically upper, middle, lower (Wurst 1999, 8) – on past societies (Paynter 1999, 184). For example, the term 'middleclass' is frequently associated in a modern context with middle-income earners or 'white-collar' occupations (McGuire 2008, 102). Today, white-collar workers include managers and secretaries. However, the latter would not be considered by most individuals to be middleclass (McGuire and Walker 1999, 161). As like today, the 'middleclass', as it developed in the nineteenth century in Ireland, was diverse, so much that it has been termed the 'middleclasses' (ibid.). There is also the danger of cultural stereotyping. For example, some archaeological studies of emigrant sites in the United States have concentrated particularly on identifying alcoholism in Irish immigrants (Griggs 1999, 89).

Many studies link economic wealth with social class, while class and status are often used interchangeably (Wurst 1999, 7; Wurst and Fitts 1999). 'Class' is best understood in terms of a *relationship* between various socio-economic groups (Lane 2010, 23). It is 'a structural phenomenon defined by the relationship of a social group to the means of production' (McGuire 2008, 102). This is essentially a basic Marxist theory, that class is an economic relationship, where one group feeds off another (Paynter 1999, 185-186). The manner in which one social group is linked to the means of production will differ to another. There is thus a strong element of economic capital. 'Class' has three main classifications. These include; an objective meaning, where class is a discrete social or economic category; a rank meaning, where class is a relative social position by birth; and a formation meaning, where class is based on perceived economic relationship (Williams 1983, 60-69; quoted in Wurst 1999, 7).

The structure of Irish society was utterly changed at the end of the seventeenth century in particular (see **Chapter 3**). The changes prevailed, in one form or another, until the start of the twenty-first century. The Battle of the Boyne (1690) obliterated the Old Irish and Old English, and heralded the Ascendency. From then on, '…there were only two cultures in Ireland: 'New English' – the culture of the dominant Protestant power-holders – and 'New Irish' – the culture of the disfranchised and embittered Catholic population' (Kumar 2003, 141). In reality, by the end of the eighteenth century this two-tiered world had expanded. Still at the bottom was the majority of the population of impoverished, politically-repressed Catholics; secondly were the Protestant dissenters, the Presbyterians (primarily confined to the north of Ireland), forming a smaller group than the Catholics, but also repressed; thirdly, and generally at the upper rungs of society, were the English Protestants (Fallon 1995, 72). In 1600 New English Protestants, those who came into Ireland after the Tudor period, made up just 2% of the Irish population. By 1700 this had reached 30% (Kumar 2003, 142).

With this in mind, it may initially be assumed that class in post-medieval Ireland was defined primarily by religion. Certainly the Penal Laws of the late seventeenth and early eighteenth centuries aimed to suppress the advancement of Catholics and Presbyterians. Gradually the laws were repealed, and certainly a Catholic middleclass, though small in numbers, had developed by the end of the nineteenth century (Smyth 2010, 11). There can be little doubt that there were poor Protestants too, mixed in with the masses of Catholic poor. To a certain degree their stories are even less well known than those of the Catholic poor (Barnard 2003). The key to understanding the class composition of Ireland in the latter part of the post-medieval period is to understand the agricultural structure that existed in the country. By the middle of the nineteenth century just 17% of the population of Ireland lived in towns with greater than 2000 inhabitants (Malcolm 1999, 177). In contrast in England, the numbers living in similar urban concentrations rose from 40% in the 1800s to 80% by the end of that century (Cherry 2005, 23). Following significant changes in landownership in the seventeenth century (see **Chapter 3.2**), Ireland's agriculture came to be dominated by a small number of landlords and massive numbers of tenants and labourers. In Ireland then, with high numbers engaged in agriculture, it may be easy to assume that class was primarily defined by a landlord/tenant division.

However, the reality was more complex. The agricultural structure comprised four social positions: cottier; subtenant; tenant; landlord (Orser 2004, 212). The cottier or bound labourer was particularly associated with tillage agriculture. He worked for a fixed daily rate for a farmer, from whom he rented a small plot of land, where he could build a cabin, raise a family and grow his subsistence crop of potatoes (Daly 1986, 18). Labourers comprised the largest proportion of the population. There were both Catholic and Protestant labourers, although Catholics formed the largest element of the class and, the further down the scale, the more Catholics there were. The subtenant and tenant were rungs along the ladder to the principal landowner, the landlord. Interestingly, a cottier could labour for an individual who was a tenant, who in turn paid cash rent to an upper tenant, with the latter in effect being both a tenant and a landlord (Orser 2004, 215). Crucially, the socio-economic classes outlined above do not actually include a significant portion of the population, that of the landless labourers and 'the destitute classes' (ibid.). The latter included 'deserted and orphan children; illegitimate children and their mothers; widows having families of young children; the impotent through age or other permanent infirmity; the sick poor, who in health are capable of earning their subsistence; the able-bodied out of work, [and] vangrancy' (ibid.).

The 1841 census was the first that categorically attempted to quantify the living conditions of the population. The classifications ranged from fourth-class house through to first-class, with cottiers and labourers largely occupying the former (Kennedy et al. 1999; Orser 2004, 215). The fourth-class comprised a one-roomed mud-cabin, the third-class house was also of mud but had between 2 and 4 rooms and windows, the second-class house was a 'good farm-house, or, in towns, a house in a small street' with between 5 and 9 rooms and windows, while the first-class house was generally of a 'better description than the preceding ones' (O'Connell 2007, 4). These standards of accommodation are the readiest measure of the numbers of poor (Barnard 2003, 281). In 1841 between 37-40% of the houses in Ireland comprised one-roomed mud cabins (Ó Tuathaigh 1990, 148; Ó Gráda and Mokyr 2006a, 80), while three-quarters of the population lived in either third- or fourth-class houses (Orser 2004, 212). Land and its ownership was a critical defining factor in terms of socio-economic status (Cronin 2010). This is the primary reason for the constant sub-division of the land among the poor, which became such a feature of pre-famine Ireland (see **Section 3.2**). By the 1840s it is estimated that about two-thirds of the population was dependant on the land (Ó Tuathaigh 1990, 129). The cottiers were the occupants of the fourth-class houses, and the figures above give some indication as to their sheer numbers by the middle of the nineteenth century. These were also the individuals that rapidly fell into pauperism and the 'destitute classes' when crises hit. That crisis could be famine or disease, both of which were rampant in the nineteenth century. From the late 1830s onwards, after the implementation of the 1838 Irish Poor Relief Act, the destitute of Ireland were no longer relieved with outdoor assistance, but instead were confined within the walls of the new Poor Law Union workhouses. These workhouses are discussed in more detail in **Section 3.3.3**.

2.6.3 Perceptions of the Irish

For most of the last millennium, Ireland's history has been intimately linked with that of Britain. Most commonly in the past 800 years this has taken the form of attempts by England, and later Britain, to subjugate Ireland in one form or another. England governed Ireland under a 'lordship' until the middle of the sixteenth century, when in 1541 Henry VIII of England was proclaimed King of Ireland (Maginn 2009, 230). The English Crown engaged a policy in Ireland that 'sought the political integration and cultural assimilation of the Gaelic polity into the Tudor state…' (Maginn 2009, 235). The assimilation failed and Ireland continued as a separate, and troublesome, neighbour to England. However, while the union of the English and Scottish crowns at the beginning of the seventeenth century was aimed to literally unite the two countries, James I (1603-1625), and those after him, pursued an agenda in Ireland aimed at colonising the country and thereby 'civilising' the Irish (Ohlmeyer 2011, 132). From the time of Henry VIII, and the English break with the Roman Catholic Church, Ireland increasingly came to be viewed by England as a possible staging point for various invasions of England by, for example, the Spanish and later the French (Fallon 1995). The control of the countries in England's immediate vicinity was a prime objective. Ultimately Scotland and England were united into the United Kingdom in the first decade of the eighteenth century, with Ireland being amalgamated one hundred years later. The Acts of Union of 1801 were to forge Ireland and Britain into one entity (Bradbury and Valone 2008, 20). The Acts attempted to define a shared tradition between Ireland and Britain, in contrast to the previous colonial relationship (Brück 2007, 227; Kumar 2003, 87). In reality, it failed miserably. While it did deal with the political problems that had emerged in Ireland by the end of the eighteenth century, it had ignored the fundamental issues that troubled Ireland, such as Catholic emancipation, land ownership, and sectarianism (Bradbury and Valone 2008, 21). Ultimately English, and later British, attempts failed in making Ireland into a 'West Britain' (Kumar 2003). Ireland remained as, and was treated like, a colony. The Irish Catholic, which formed the majority of the population of the island, was viewed by the British as the 'enemy within' (McGrath 1996; Spencer-Wood and Baugher 2001, 7). In reality there were never enough Protestants of different ranks in Ireland, and they did not branch out into the rural areas enough to adequately run Ireland as an integral part of Britain (Barnard 2003, 329). Events, such as commemorations of Protestant victories, for example, over various native rebellions or the Battle of the Boyne, and celebrations of the British monarchy, were meant as reminders to Protestants to reiterate their Britishness and to be ever vigilant against the Catholic masses (Fleming 2002, 102; Kelly 1994).

In referring to perceptions of the Irish, and invariably it is of the comments on the Irish poor by British individuals, it is important to be aware of the nature of the records. The contemporary accounts that are available are primarily from the point of view of those that were not of that class. Those who commented or recorded details on the Irish poor were drawn from a wide group including travellers/tourists, landlords, politicians, philanthropists, and social commentators, to name but a few, each with their own inherent biased opinions towards the poor. Historical records are 'controlled and composed by the victors, the literate and the leisured' (Barnard 2003, 330). The records were interpretations of the existences of the poor and, ultimately, a means of control (Garman and Russo 1999).

The English establishment, at least from the time of the sixteenth century plantations, viewed the Irish as essentially uncivilised, in comparison to the 'rational and restrained' English (Kumar 2003, 62). Charles O'Hara, an eighteenth century landlord, referred to his Irish tenants as 'the lowest species of slaves' (Barnard 2003, 243). The high numbers of individuals in the lower ranks in Ireland was, in Britain, linked with the backwardness of the Irish (Barnard 2003, 279). The incursions into Ireland were for the 'moral and material improvement' of the island and her people (Canny 1989, 174). Consequently, the rebellion of 1641, along with later uprisings, was viewed by the English as an affront to their efforts to civilise the Irish (Canny 1989, 199). A Quaker travelling in the Cork/Limerick region in the eighteenth century commented on 'poor slovenly Ireland, overrunned [*sic*] with sloth and idleness' (Barnard 2003, 290). This was particularly linked with the manner of living that the Irish cottiers, labourers, and tenants engaged in with relation to their subsistence crop of the potato, where to outsiders they appeared to spend a marginal amount of time working and an inordinate amount of time being idle. The Victorians linked perceived ape-like physical traits in the Irish with uncivilised behaviours and low intelligence (Curtis 1997). For example, the infamous words of Charles Kingsley, the noted British clergyman and writer, on the Irish read: 'I am haunted by the human chimpanzees I saw along that hundred miles of horrible country. I don't believe that they are our fault. I believe that there are not only more of them, but that they are happier, better, and more comfortably fed and lodged under our rule than they ever were. But to see white chimpanzees is dreadful; if they were black, one would not feel it so much, but their skins, except when tanned by exposure, are as white as ours.' (Kingsley 1881, 111-112; Duffy 2007). Caricatures of the Irish as apes and monsters in British publications were used to justify imperial rule in Ireland (Pearl 2010, 112ff). Despite the fact that there were both Protestant and Catholic poor (Murphy 2003, 12), albeit with significantly higher numbers of the latter, the Irish Catholic poor were ill-favoured even among certain charities. Protestant poor in Ireland were more favoured in terms of charity over their Catholic counterparts in eighteenth century Ireland (Barnard 2003, 318).

The perceived wild, uncivilised nature of the Irish was seen to be reflected in the descriptions of landscapes made by travel writers in the nineteenth century in particular. Cultivated land was described as rich and productive, while bogs in particular were targeted as a sign of the savageness of the Irish (Brück 2007, 230). Ireland's failure to exploit her natural resources was taken as further proof by England that she had to be coerced and cajoled like a child (Canny 1989, 173). It was a typical colonial relationship, whereby the resources of the colonised country should be exploited to the advantage of the occupying country (Brück 2007, 229). It also legitimised the colonising of the country because, from the British perspective, the Irish were incapable of exploiting their own resources (ibid.). 'The Improvements', in terms of agriculture and landscape in particular, of the eighteenth and nineteenth centuries were attempts to make the Irish countryside more British, more productive, and more safe. The aim was to change the Irish poor into the romanticised version of the contented peasant, who knew their place in the world (Brück 2007, 229). British policy during the Great Famine has been linked with the prevailing concept of the time: the Irish cottiers and labourers were not fit to manage the land, as it was not in their nature, and the sooner the land was in more responsible hands the better (Nally 2008). Roads, and later railways, opened up the previously inaccessible landscape, somewhat banishing the hideouts of various rebellious factions, while at the same time contributing to the social and economic development of the country (Brück 2007, 230; Ó Tuathaigh 1990; Thompson 1981, 195). Of course philanthropic works also conferred power on the bestower (Barnard 2003, 281). While philanthropy and social improvement were important, there 'was a nervousness about advancing too many into better stations too quickly' (Barnard 2003, 326).

The low status of the poor in Ireland was mirrored in Irish emigrants. Ironically, most of these were individuals who at least had the means to emigrate, suggesting that many of them were marginally better off than the individuals left behind. Indeed, a certain amount of this 'wealth' has been identified in Irish immigrant populations in New York (Griggs 1999). Most Irish immigrants were not immediately welcomed in their adopted countries, and similar disparaging views of the Irish aboard are known. Francis Place, the nineteenth century British social reformer, when commenting on the Irish in St Giles in London in 1816, wrote: 'this account is no doubt correct, and is a fair picture of the manners of a much larger proportion of the people half a century ago. Such people...are now only to be found in a few places, such as the back settlement of St Giles, some places in the parish of St Luke and Ratcliffe Highway, and almost wholly among the Irish. The poorest and most dissolute people in Spitalfields are several grades above the mere Irish' (Boyle et al. 2005, 35). The living habits of the emigrant Irish in London were frequently held up to ridicule and scorn, and were seen as a direct reflection of the poor characters of the Irish in general (Wohl

1983). Friedrich Engles, while being primarily concerned with the poor in Britain, was appalled at the conditions of the incoming Irish (Ward 2004, 117). Their apparent lack of motivation and the perceived slovenly habits were seen as a threat to the good character of the British working man. The Irish were essentially a contaminant (Pearl 2010, 111-112). The Irish emigrants that landed in the United States in the eighteenth and nineteenth centuries were similarly considered to be the lowest rank of all immigrants and, like their counterparts in Britain, suffered significant marginalisation (Brighton 2011; Ignatiev 1995).

The basic fourth-class cabin described above became somewhat iconic in British travel writing and to social commentators of the day, due to its basic nature, which essentially offended the British sense of hearth and home (Barnard 2003, 281; Brück 2007, 241). However, some evidence suggests that the Irish poor were not particularly materialistic and placed little value in actual possessions (Barnard 2003, 281-282; Griggs 1999): thus, what may have appeared abject poverty to the outsider may have been more than adequate to the person living in that environment. For much of the eighteenth and nineteenth century outward appearances were seen as a reflection of inner worth, although this view waned in the latter part of the nineteenth century with a greater emphasis among the wealthy on restrained modesty (Barnard 2003, 327; Richardson 1989). The poor in Ireland formed the largest proportion of the population. If the Irish Catholic poor in particular, held a lower regard for material possessions than those commentating on them, then the poor may appear particularly impoverished.

While the archaeologist must always be wary of imposing modern views on the past, there can be little doubt that people in the past imposed their views of the world on their contemporaries who, in reality, may have lived with entirely different and alien social norms. The extreme poverty evident to the modern Western traveller to many countries in the Third world may initially appear horrendous. In reality people born and bred into specific situations may be resilient to conditions that people in better conditions may abhor. English Whig George Cooper observed of the Irish poor that 'the condition of the West Indian negro is a paradise to it. The slave in our colonies has meat to eat and distilled spirits to drink, whilst the life of the Irish peasant is that of a savage who feeds upon milk and roots [potatoes]' (Whelan 2004, 234). However, we do not have the words of the poor on how they saw themselves. As has often been quoted 'history is written by the victors', and much of our perceptions of the poor in post-medieval, and particularly nineteenth century, Ireland are formed by the writings and records of individuals who were generally better off. While the perception then of the poor in Irish society may be biased particularly by colonial thoughts, the perception, and indeed treatment, of those on the lowest rung of society – the pauper - is perhaps more tangible.

2.6.4 Paupers and the Destitute

Post-medieval opinions of the poor had its origins in the sixteenth century Calvinist Protestant Reformation, when labour became linked with morality (Spencer-Wood and Baugher 2001, 6). Unwillingness, perceived or otherwise, to engage in the former, meant one was lacking in the latter. Increasingly, the poor came to be viewed by the middle and upper class with suspicion and as dangerous to civilised life (Cannadine 2002; Brück 2007; Spencer-Wood and Baugher 2001). The numbers of poor and vagrants increased, at least in England, after 1500 as a result of war, disease, and environmental conditions (Huey 2001). Given the data on the numbers of poor in Ireland by the nineteenth century (see above), it is apparent that this was also the case in Ireland, albeit for differing reasons, and pauperism increased dramatically (see **Chapter 3**). Even prior to the Great Famine of 1845-1852, three-quarters of the population of Cork city were paupers (O'Mahony 2005b, 31). Poor relief became increasingly secularised, in contrast to the traditional medieval association with religious foundations (ibid.). There was also an increasing desire to confine these paupers into institutions and away from decent society, instead of providing them with outdoor relief. By the end of the 1830s Ireland's paupers were being ushered behind the walls of the infamous Poor Law Union workhouses (see **Section 3.3.3**).

In general, it was perceived that the destitute in Britain and Ireland went against the morality of the values of eighteenth and nineteenth century. Being working-class at least conformed to some of the civilised principles of self-reliance, self-restraint, obedience, and diligence (Crossman 2010, 131). In contrast extreme poverty and pauperism were seen as a moral failing (Smyth 2010, 8). The pauper was broken, the desire to improve was gone, and 'dependency and degradation were the results' (Rose 1988, 57). The solution, first instigated in Britain and later translated to Ireland, was to separate the pauper away from society, most infamously in the Victorian workhouses of the Poor Law Unions. The poor were poor through their own fault and the workhouse was designed to chastise them for their indolence, rather than to actually alleviate real suffering. It essentially institutionalised, criminalised, and punished the pauper (Spencer-Wood 2009). S/he would either be 'cured' or may have to be kept separate from society forever for fear of contagion

(Rose 1988). In his sobering tour of Union workhouses in the west of Ireland in 1850, Lord Osborne observed that 'dogs would have had more attention paid to them' than the paupers in the workhouses (Osborne 1850).

As the post-medieval period progressed, there was an increasing emphasis on the 'deserving poor' and the 'undeserving poor'. The former were those who were poor through an act of God, such as through illness, injury, deformity, or death of a spouse or parent (Baugher 2001, 197; Spencer-Wood 2001, 117). The 'undeserving' were those who, it was perceived, chose not to pull themselves out of the sin of poverty and destitution. In the United States, the institutions that were constructed to deal with these different 'classes' of paupers, differed also (Baugher 2001). For example, in New York the 'deserving poor' were housed in the almshouse, while the 'undeserving poor' were confined to the Bridewell, the latter being a term synonymous in Ireland and Britain with a prison (ibid.). The initial emphasis of the almshouses of the United States was on rehabilitation, in contrast to the punishment element of the British (and Irish) workhouse (Garman and Russo 1999, 120). It appears that, in general, most paupers, and others of the destitute classes, in Britain and Ireland were forced into the workhouses. The use of the term 'workhouse' for the destitute was intimately linked with the Evangelical Protestant belief that sin, (as mentioned above, pauperism was deemed a sin) could be redeemed through penitence, including labour or at least keeping the body active and thus away from temptation (Spencer-Wood and Baugher 2001, 6). A similar penitential ethos was apparent in the Magdalene asylums, where 'fallen' women were incarcerated for perceived moral failings (Finnegan 2001; Smith 2007).

If 'class' is considered as a relationship between various socio-economic groups (Lane 2010, 23) (see **Section 2.6.1**), then in effect, the destitute classes essentially had no relationship with the means of production, rather they had to rely on it for existence. This, reliance rather than contributing, was part of the reason why the destitute class in particular were treated poorly by society at large (see below). While paupers were essentially confined for not contributing to society as a whole (or indeed to their own morality), ironically the set-up of the workhouses ensured that they contributed little to society from within the walls of those institutions either.

In life then, the pauper was perceived by most as the lowest form of humanity. They were 'people at the margins' (Turner and Young 2007). In fact, the poor were 'traditionally regarded as almost of another species', lacking the humanity of the classes that had any money (Marcus 1985, 146). Instead of the earlier outdoor relief of the poor, by the nineteenth century the emphasis was firmly on the sin of poverty and the need to incarcerate the pauper for the good of society. The high, enclosing walls of the Poor Law Union workhouses was a core feature in this premise, specifically designed to confine the pauper (Spencer-Wood 2009, 133). Today, where these walls still survive intact, such as at Mitchelstown in Co. Cork, they are very visually imposing. In stark contrast, the American almshouses (mentioned earlier) lacked such elements (Spencer-Wood 2009, 133). Everything in the Poor Law Union workhouses, from the physical structure of the building to the regime within the walls, was designed to control the pauper. The stigma of the Poor Law Union workhouse environment, it could be argued, was also imbued in the fact that, being confined, the inmates could not contribute with any great significance to society (Reidpath et al. 2005). Certainly inmates were put to work, including breaking stones, grinding corn, working on the lands of the workhouse, mending clothes, and laundry, but it was primarily a method of counter-acting the adage of 'the devil makes work for idle hands' (O'Connor 1995, 103). Indeed, entering the workhouse had a very strong stigma attached to it (O'Connor 1995). Perhaps it was akin to the 'social death' encountered by those entering psychiatric institutions in modern studies, which embodied an element of abandonment and rejection by society, as well as a relinquishment of responsibility by the family. This may also be transcribed to the workhouses of the nineteenth century. What shred of individuality a person had outside the workhouse was lost within its walls, not least of all with the use of a uniform (Baugher 2009, 7; Piddock 2001, 77).

In addition to the confinement aspect of the workhouses on the living body, with the separation of the morally-corrupt individual from good working society, those who died within the walls were also considered separate in death. The paupers had failed to support themselves in life, and in death they were a further burden on society. Prior to the workhouses the burial of paupers was the onus of the parish. Under the Poor Law system their burial was the responsibility of the Poor Law Union. Thus, at the expense of the Union, the pauper was buried in a designated workhouse cemetery, forever to be isolated from 'decent' society. Modern sociology refers to the 'shameful death' in terms of institutions and geriatric care (Kellehear 2009). It is possible to transcribe at least some of 'the shame, stigma and loneliness of death in institutionalised old age and in poverty-related contagion' (ibid., 62) to the stark workhouse institutions of the nineteenth century.

The Christian concept of the 'good death' and the 'bad death' has been evident since at least medieval times (Houlbrooke 2000), although it is a concept that has been identified in numerous cultures around the world (Bloch and Parry 1982). Put simply, it encompassed the basic notion that a good death was where an individual received the Last Rites of the Christian religion, and was thus set on the road to Heaven. In a bad death these Rites were denied. The latter could include death by murder or in battle, or in cases of suicide, for example. By the manner and/or circumstances of their death, these individuals were denied entry to Heaven. However, attempting to translate this concept of a good or bad death into the archaeological interpretation of a site would be ill-advised in most cases. For example, it may traditionally be assumed that individuals with significant physical disabilities surviving into adulthood were afforded a certain level of care, and therefore compassion, by the community at large (Tilley 2012). The danger lies in the actual imposing of modern views of disability and how it should be dealt with, on communities that lived sometimes millennia ago (Dettwyler 1991; Roberts 2000a).

Those who suffered a 'bad death', or indeed those whose death was interpreted by the community as being a 'bad death' may have then been subject to differential and separate burial. The mass grave of soldiers slain in the Battle Towton in England in 1461 is an excellent example of the mass informal burial of those killed in war (Fiorato et al. 2000). In Ireland a cemetery in Carrickmore in Co. Tyrone is known as *Relig na Fir Gunta* [sic] or 'Cemetery of the Slain/Wounded Men' (Hamlin and Foley 1983), while *Teampull-na-Bhfear-ngonta* [sic] or 'Church of the Slain Men' is located on Inishcealtra island in Co. Clare (Lenihan 1889; Wakeman 1879). In the case of the paupers in the Irish workhouses, there is no suggestion made here that the pauper was considered in the same category as those relegated to burial in unconsecrated grounds referred to earlier (Murphy 2008; Murphy 2011). However, they were still separated out from society in death, albeit in consecrated ground. Perhaps it was feared that the perceived sinful nature of the pauper's soul may prove harmful to the souls of those of polite society if both were interred in the same cemetery. Ultimately the burial of the pauper was a reflection of perceived 'social worthlessness, earthly failure, and profound anonymity' (Laqueur 1983). While initially some pauper dead were buried in the 'ordinary' cemetery of the community (O'Connor 1995, 148), this was quickly abandoned in favour of separate cemeteries for the paupers.

This may certainly have been related to the sheer numbers dying in the workhouses during the famine, but there can be little doubt that it was in fact favoured by the community at large. Thus the living pauper and dead pauper were linked in a separate existence from 'normal' society. The act of corralling the paupers into the workhouses ensured that this separation from society in life was continued in death. It is clear that the treatment and disposal of the dead was, and is, defined by society's perception of that individual or the role that was required of that individual in death for the benefit of society (see **Section 2.2**) (Sofaer 2006; Sofaer Derevenski 1997). Added to this separation was the fact that those in the workhouses were been denied the traditions associated with Irish funerals in the nineteenth century. This particularly refers to the wake, where the body, and therefore the soul, of the diseased was never left alone until burial, and the life of the individual was celebrated by kith and kin (Aiken 2001). The treatment of the dead and what is done to the corpse, where it is placed, and how it is remembered is a universal factor across time and space (Parker Pearson 1999, 44). In Lewis Binford's theory of 'social persona', the notion that there is 'a composite of the social identities maintained in life' (Binford 1971, 17), which may be symbolised in the treatment of the dead individual (Tarlow 1999, 10). This is very much reflected in the workhouse burials. The treatment and remembrance of the dead pauper reveals directly how society perceived these individuals. As they were to be excluded and forgotten in life, so they were to be excluded and forgotten in death (Garman and Russo 1999).

Interestingly however, recent archaeological investigations have contradicted one of the most frequently told stories of the workhouses, particularly at the time of the Great Famine; that of the coffin with the sliding bottom. A common opinion in Ireland is that coffins with sliding bases were often used in the burial of the multitudes that died in the Great Famine, as there were not the resources to cope with the sheer numbers of individuals that were dying. Yet extensive evidence of coffins has been uncovered at the workhouse sites used in the present study. Evidence from another workhouse site, Tuam workhouse in Co. Galway, (works completed after the present study) indicates that coffins were used there also, in the context of mass graves (Eachtra Archaeology, pers. comm.), while coffins were also used in the large numbers of mass graves pits associated with Kilkenny workhouse (Jonny Geber, pers. comm.). Coffins have also been identified in the mass pit burials recently subject to rescue excavation in Borrisokane in Co. Tipperary (Lynch 2009). Similarly, coffins have been identified with burials associated with the convict prison (1847-1883) at Spike Island in Co. Cork (B. Ó Donnabháin, pers. comm.). Admittedly, in some instances these may have been less like coffins and more like 'undressed boards slightly nailed together…', as was remarked about famine coffins in Cork city in 1847 (Kinealy 2006, 173). By 1811 in Manchester, England, pauper coffins which previously had been 'of an ordinary sort', were now 'ribbed only on the lid, made of the cheapest pine, specified to be only 3/8" thick on the sides, 1/2" on the lid, 5/8" on the ends for the small coffins; somewhat thicker all around for the bigger ones' (Laqueur 1983, 121). However, even ramshackle coffins were better than none. Due to intense financial pressure, and despite strong protests, the supply of coffins for the dead of Mohill Union workhouse in Co. Leitrim had to cease in April 1847 in favour of providing food for the living (MacAtasney 1997, 48-49). Coffins are a reflection of separating the living from the dead, as well as sanitation. They also reflect however the individualisation of the person (Parker Pearson 1999, 54-55), which appears to have been afforded to paupers where, even in the most adverse of situations, when mass graves were required, coffins were provided. This is despite that fact that entry into the workhouse system denied their identity.

However, apparent dignity afforded was not universal. A probable anatomical specimen of a dissected infected adult elbow joint was recovered in the base of a mass grave in Borrisokane recently (Lynch 2009), and autopsies/dissections have been recorded in other workhouse burials such as Kilkenny city (Jonny Geber, pers. comm.). In 1832 the Anatomy Act provided that corpses of paupers could be used for dissection by the medical profession: previously they were limited to the corpses of executed criminals. As such, dissection and the dreaded cutting, dismembering, and displaying of body parts, became a punishment for pauperism and a reflection of how the pauper was perceived as an object to be used at the disposal of society (Nystrom 2011; MacDonald 2005; MacDonald 2009; Richardson 1987). Some of the reasoning behind the Act lay in the premise that it would firstly discourage the poor from seeking relief (and thus the possibility of dying a pauper within the workhouse), and secondly that the actual medical use of the body would be a type of posthumous payment by the pauper for their burden on society (Sappol 2002, 4). Those that emigrated did not escape either as the high mortality among Irish emigrants who ended in pauperism in the United States ensured that many went to the anatomists table (Sappol 2002).

Clearly then, the pauper, was, by the nineteenth century, considered the ultimate burden on society. The poverty-stricken lower classes were only a short step away from falling into the pit of destitution and pauperism. Increasing stresses on the poor in the nineteenth century in particular ensured that, when the Great Famine finally hit in 1845, it was the beginning of fundamental changes to all aspects of Irish society. The next chapter will examine the historical context of this study, looking at the early centuries of the post-medieval period and the foundations that formed the development of the social and economic conditions that came to prevail in Ireland by the start of the nineteenth century.

CHAPTER 3:
Historical Background: Situating the Data

3.1 Introduction

This study focuses on the skeletal evidence of health in post-medieval Ireland, from the sixteenth through to the nineteenth century, but particularly on the latter part of the period. By the nineteenth century in particular, Irish society had developed into a number of distinct broad-ranging classes. As noted in the previous chapter, there was a disproportionally large poor class, primarily comprising rural-based tenants and labourers who were Catholic, but also with significant numbers living in appalling conditions in urban areas. There is no doubt that there were also some Protestant poor. By the end of the eighteenth century, the potato formed the basic subsistence food of the poor, and they were the individuals that were particularly decimated by the Great Famine of 1845-1852. A small land-owning class primarily comprised either English Anglicans, newly-arrived in the post-Reformation period, or descendants of the original Anglo-Norman families associated with the initial twelfth century invasion, most of who had converted from Catholicism to Protestantism. The eighteenth century also saw the development of 'the middling classes', as advances in industrialism and agriculture, and the associated merchants and dealers, along with the increasing globalisation of trade networks, allowed the development of modern economic trade. Despite, or probably because, of legislative measures severely limiting Catholics from owning land, Catholics were increasingly prominent in the merchant class, where the ownership of land was not the foundation of business, in contrast to agriculture.

But just how did these socio-economic groups develop? From the sixteenth century onwards Ireland was witness to massive upheavals in terms of social, cultural, agricultural, industrial, and political change. The Ireland that emerged into the twentieth century was virtually unrecognisable from the Ireland of the sixteenth century. In those four hundred or so years, the transformation of the people and land of Ireland was arguably the most dramatic in all of the human history of the island. The transformation was intimately defined by the very close ties over the centuries with Britain. In the mid-eighteenth century the major colonial world power's comprised Great Britain, Spain, Portugal, The Dutch Republic, and France. One hundred years later, the British Empire was unrivalled (Ward 1994, 44). Ireland, through a succession of events, culminating finally in the Acts of Union of 1801, was inextricably tied to Britain, perhaps most significantly in just how physically adjacent the two islands are. The Acts of Union essentially dissolved Ireland's previous status, whether real or imagined, as a colony, and instead sought to integrate Ireland as part of the United Kingdom of Great Britain and Ireland. As will be seen, Ireland's link with Britain increasingly ensured that her social and economic history became more influenced by British, European, and world affairs. But what happened in Ireland in the preceding centuries that allowed the development of an enormous number of people, existing at subsistence level in agriculture, at a time when the Western world, and Britain in particular, was rapidly modernising and when Ireland was essentially defined as an integral part of the United Kingdom? It was Ireland's intense relationship with Britain, which ultimately moulded and constructed the economic and social formation of the island, that resulted in the devastating and cataclysmic events surrounding the Great Famine of 1845-52 and the aftermath.

3.2 Post-medieval Ireland

Although English interests in Ireland may be seen to begin with the Anglo-Norman invasion in 1169, in reality it was not until the sixteenth century that Irish history became inextricably linked and influenced by events and policies in England (Ellis 1998). Until that time, England was largely concerned with internal struggles or to dealing with issues relating to more threatening, or more strategically important, neighbours, such as with France in the Hundred Years War (1337-1453). That was immediately followed by the War of the Roses (1455-1485), a civil war for the throne of England which ultimately led to the establishment of the Tudor monarchy in 1485 under Henry VII (Curry 1993; Lander 1993). It was under the second Tudor monarch, Henry VIII (reigned 1509-1547), that English involvement in Ireland became more focused (Ellis 1998). From the time of the initial Anglo-Norman invasion England had governed Ireland under a 'lordship', and Ireland was essentially a 'frontier' of the fledging English overseas expansions (Gibney 2008, 178). The relationship was strained and mostly unsuccessful so that by the sixteenth century English rule was largely confined to the areas of the Pale, centred on Dublin and other urban areas. The remainder of Ireland was ruled by the native Irish and by the Old English, descendants of those who had conquered territories following the initial Anglo-Norman invasion in the twelfth century. The Old English had, rather infamously and to the consternation of the English Crown, become more Irish than the Irish themselves. In 1509 Henry VIII succeeded to the English throne and his centralisation of power in the monarchy led to English policy in Ireland taking on a more intense role. In 1541 Henry VIII was proclaimed King of Ireland, a policy that in one instance recognised the individuality of Ireland (such as the contemporary Kingdom of England and the Kingdom of Scotland), while in another tightened the grip of England on Ireland (Maginn 2009, 230). While the Tudors may have wished to integrate Ireland more closely with England, in reality, there were never enough resources allocated to match the policies that sought to deal with Ireland. In a sense the political will was also missing, and crucial factors were overlooked, particularly in terms of religion, where Ireland remained largely Roman Catholic in comparison to Britain (Ellis 1998).

Tudor rule in Ireland was answered through numerous rebellions, particularly by the Fitzgerald clan in the Desmond rebellions. The Nine Years War (1594-1603) finally achieved through military action what the Crown had failed to do through political action in the previous half century – drive the old Gaelic chiefs out of Ireland and bring the country closer to Britain (Gibney 2008; Morgan 1993). The start of the seventeenth century saw the infamous 'Flight of the Earls', when the last leaders of the old Gaelic order in Ireland went into exile on the continent. There was a resurgence in turmoil in the mid-seventeenth century when Ireland was ravaged by the Confederate Wars, which were sparked by the rebellion of 1641, a particularly vicious event which resulted in ethnic-cleansing on all sides by both Catholics and Protestants. The Confederate wars trudged on intermittently for 11 years (1641-1652). Following the English civil war, and the formation of the Commonwealth under Oliver Cromwell, there was a renewed effort to control events in Ireland. The Cromwellian conquest (1649-52), brought about the end of the Confederate wars in Ireland, and the brutality of the campaign has frequently been linked with the, either real or perceived, massacres of Protestants by Catholics during the 1641 rebellion. The century closed with the Williamite wars (1688-1691), which raged across the countryside and culminated in the Battle of the Boyne and the signing of the Treaty of Limerick. The defeated Jacobite army fled for the continent in the 'Flight of the Wild Geese'. The social pattern of Ireland was changed utterly from the initial Tudor renewal of interest in the affairs of the island in the sixteenth century, through the recurring wars of the seventeenth century, particularly in terms of landownership. The end of the seventeenth century saw the emergence of a British-orientated, Anglican, landed class, the so-called 'Ascendency', and a majority of landless Catholics, whose only access to land was as tenants.

It was these changes in landownership in the sixteenth and seventeenth centuries that came to define Ireland in the latter centuries of the post-medieval period. These changes were primarily achieved through the use of a plantation system, where the lands of the dispossessed Irish were taken over by newcomers from England or by already Irish-based, but loyal-to-the-crown, individuals in Ireland. Many of the 'New English', who came to Ireland from the Tudor period onwards, were intent on making their fortunes. The reality was that, due to the lack of natural resources in Ireland, that fortune was in land-acquisitions and in the subsequent produce from the land (Ellis 1998). Prior to the industrial revolution, economy was based around agricultural output in particular, and the utilisation of agricultural produce. Land acquisitions involved the redistribution of the landowners, with the inevitable primary effect being that the native Irish landowners, and at least some of the 'Old English' landowners from the Anglo-Norman invasion, were forced off the land.

A plantation, in the most classic form, was to consist of a loyal, industrious, wealthy, conforming Protestant (that is, Anglican) English subject, who was to take control of designated lands in Ireland, 'plant' them with similar loyal English subjects and make the land profitable and of benefit to the greater good, that is England. Landowners and tenants were to be politically screened for suitability, and there were specific requirements in terms of the need to construct defensible buildings on the new estate (Andrews 2000, 140). As well as making the land more productive, there was also a strong emphasis on the need to civilise the Irish, for their own good, but also for the benefit of the newly-emerging British Empire (Ellis 1998; Ohlmeyer 2011). It has been argued that such a definition only applies to the plantations of the sixteenth and early seventeenth century, as the later 'land-transfers' of the Cromwellian, Restoration, and Williamite periods did not impose any 'demographic or architectural specifications on the incoming landowners' (Andrews 2000, 141). That may be the case, but those later plantations still involved the removal of the native Irish and Old English as landowners (Gibney 2008). An important factor in the case of the latter was that many had retained their original Catholic religion, in contrast to the conforming Protestant Anglican religion of England. The allegiance of the Old English was increasingly towards Ireland and their own interests, rather than the interests of the English Crown. In the popular mind the displacement of the native Irish in particular is perhaps best epitomised by the seventeenth century words of Oliver Cromwell 'to hell or to Connaught', which was the choice given to the mass Catholic populace of Ireland. The first detailed proposal for a plantation was for Leix (Laois) and Offaly in 1515 (Andrews 2000, 140), with variations of plantations continuing right up to the Williamite period. Slowly but inexorably, English administrative systems spread throughout the former Old Irish lordships, essentially imposing an English model of local government, through the gentry and the 'middling sort' on the old Gaelic, and indeed Old English, lordships (Ellis 1998). By the seventeenth century the old order of Gaelic and Old English Lords was gone and the new landowning class of English Anglicans, the Ascendency, was ensconced (Murphy 2003, 12). Some landowners genuinely sought to improve their estates (Breen 2007). However, the spectre of the 'absentee landlord' became a prominent feature in the plantations of Ireland, particularly in the nineteenth century, where the new elite preferred the safety and civility of Britain over the insecure social order in Ireland (Barnard 2003; Barnard 2009).

The English involvement in Ireland in those centuries was fundamentally different to the other most comparable country, that of Scotland. At the start of the seventeenth century the crowns of England and Scotland were united, while one hundred years later the parliaments of the two were amalgamated. In contrast, the agenda of James I (1603-1625), and those after him for Ireland, was aimed at colonising Ireland, for the benefit of England, and civilising the Irish (Ohlmeyer 2011, 132). Perhaps it was the fact that Ireland was an island, rather than physically connected to England like Scotland was, that was a paramount factor in England's involvement in Ireland. From the earliest Anglo-Norman invasion, with the writing of *Topographia Hibernica* by Giraldus Cambrensis, through to the social commentators of the nineteenth century, the native Irish were viewed on with a mixture of fascination, pity, and abhorrence, particularly in terms of their perceived savagery and uncivilised nature. Indeed, many of the rebellions of the Irish against British authority, such as in 1798, 1848, and 1916, were seen in Britain as evidence of the ungrateful and anarchic attitude of the Irish.

One of the most fundamental flaws in the governing of Ireland, that had serious implications from the sixteenth century onwards, came as a result of the Reformation. There was a critical shift in religious beliefs in England at the time when English interest in Ireland was increasing. That shift did not occur in Ireland. Protestantism, and ultimately the Anglican tradition, became established as the religion of the ruling elite of Britain, while

Catholicism remained as the religion for the majority in Ireland. Ireland was virtually unique in respect that, unlike most European countries, the religion of the main populace was different to the ruling class (Lyttleton 2009). When Protestantism became the common religion of England, relations with the primarily Catholic population of Ireland became increasingly more complex and strained. Religious intolerances played a huge role in both the Confederate and Cromwellian wars of the seventeenth century, and arguably continued to play a significant role right into the present century. There can be little doubt that religious differences were one of the key elements to Ireland's designation as a colony, as opposed to an integral part of Britain. From the seventeenth century onwards, in order to fully participate in civic, and indeed political, life an individual had to conform to the established Anglican Church. As will be seen, this excluded the main population of Catholics, but also the non-conforming Protestants primarily in the north of Ireland, the Presbyterians (Murphy 2003, 13). Firstly through force, and later through legislative measures, Britain sought to increase her control in Ireland.

It has been shown thus, that Ireland, from the sixteenth century onwards, firstly through the Tudor monarchs and later through the Stuarts, the short-lived Commonwealth (under Oliver Cromwell and his son), and the Restoration, endured wave after wave of land 'redistributions'. It resulted in a massive and fundamental shift in landownership in Ireland, one that was to echo through the centuries and to culminate with devastating effect in the middle of the nineteenth century (Smyth 2006). In 1603, the year of the coronation of James VI of Scotland as James I of Ireland, England, and Scotland, most of the resident peers in Ireland were Catholics (88.9% or 24/27) (Ohlmeyer 2011-136). By 1641 more than half were Protestant (52.9% or 36/68) (ibid.). It has also been estimated that, in that same year of 1641, 59% of the land was held still by Catholics (Bradbury and Valone 2008, 15). By 1660 this had dropped to just 10% (ibid.). There were variations. For example, there were differences between rural and urban areas. Concerted efforts were made to expel Catholics from urban area, which were seen as the ultimate sanctuary of the English Protestants. However, in reality all urban areas outside of Ulster retained sizeable populations of Catholics (Barnard 2003, 20). There were also significant variations in the numbers of Protestants and Catholics in terms of general locations. An estimated 81% of the population of Co. Antrim was Protestant in 1732, compared with just 5% in Co. Galway (Barnard 2003, xvii). Crucially, while civic offices were limited to conforming Protestants, in reality there were never enough Protestants of different ranks in Ireland, and they did not branch out into the rural areas enough to adequately run Ireland as an integral part of Britain (Barnard 2003, 329).

The colonial status of Ireland, at least prior to 1801, is aptly indicated by the so-called Penal or Popery Laws, a set of laws designed to control the main mass of the population, that is, the Catholics. Just as the Statues of Kilkenny in the fourteenth century sought to control the population, so the Penal Laws, first enacted in the late seventeenth century, were aimed at subduing and controlling the main Catholic population, as well as the minority of non-conformist Protestants, the Presbyterians, both of whom were seen as a threat to British Protestant interests in Ireland (Canny 2001; Gibney 2008). The laws were somewhat random, enacted over a span of almost fifty years, typically as reactive measures to events, rather than a single consorted effort (Connolly 1992, 263). The Irish Catholic in particular was considered by the British establishment as the 'enemy within', and as such needed to be kept under strict control (McGrath 1996). The range of issues the Penal Laws addressed was vast, and included restrictions on the ownership of weapons and horses, on teaching, on intermarriage, on the holding of public offices, and on the clergy (Connolly 1992).

However, it was in relation to landownership that the laws had the greatest effects. The laws were the final push by the British establishment to remove the rebellious Catholic landowners, and to restrict their engagements in normal social interaction. Specifically the so-called Popery Act or 'Act to Prevent the Growth of Popery' of 1704 decreed that if a Catholic landowner died, his estate was to be equally divided between his sons. However, if his eldest son converted to Protestantism then that son would inherit the entire estate (Connolly 1992, 273). The law was directed specifically at the remaining Catholic landed class, in order to reduce the surviving numbers of Catholic landowners and thus diminish any powers that such ownership would endow to the Catholics. Civil and political power was intimately linked with the amount of property or estate that a male possessed. In reality however, just as the formation of the Penal Laws was largely reactionary, the implementation of them was also rather arbitrary and fluid. For example, in 1750 Catholics were allowed into the lower levels of the army, while in 1771 the 'Bogland Act' allowed Catholics to lease 50 acres of unprofitable land (Ó Tuathaigh 1990, 42-3). Overall however, the laws significantly limited the prospects for the main population of Catholics. When Britain began to face increasing threats from France in the eighteenth century, the laws were increasingly compromised. This was in an attempt to make allies with Ireland so that the island would not be used as a staging point for a French invasion of Britain. Hence

Gardiner's First and Second Catholic Relief Acts of 1778 and 1782 respectively, and Hobart's Catholic Relief Act of 1793 allowed additional rights to revert to Catholics, particularly with regards to land, if an oath of allegiance was sworn (Ó Tuathaigh 1990, 42, 45). In addition, while the Penal Laws were problematic for Catholic (and Presbysterian) landowners, they were not such a significant issue for Catholic tenants or merchants. Indeed the latter performed relatively well under the Ascendency, and in 1775 about one third of the wholesale merchants in Dublin were Catholic, as were approximately one quarter in Cork (Murphy 2003).

Given some of the concessions that had been granted to Catholics by the British establishment by the end of the eighteenth century, often in direct conflict with the spirit of the original Penal Laws, the rising of 1798 shook the British government and the Ascendency to the core (Connolly 1992, 317). Agrarian violence, in response to the high levels of insecure tenancies, had certainly increased by the end of the eighteenth century, perhaps most famously through the activities of the Whiteboys (Wall 1973). However, 1798 was still unexpected and the response from the British establishment was swift and brutal, with many of the executed rebels buried in what was to become known as the Croppy Acre near the Liffey in Dublin. Although the rebellion ultimately failed, its very occurrence hardened British opinions against the Irish. Combined with a strong anti-concession lobby and the open hostility of King George III, the rebellion ensured that Catholic emancipation, or indeed any concessions, did not form part of the Acts of Union of 1801 (Ó Tuathaigh 1990, 49). Ironically the 1798 rising, which had aimed to sever ties with Britain, resulted in the tightening of the Empire's reigns in Ireland. Much of Ireland (excluding Ulster) had essentially come to be seen as the errant child of the Empire, and needed to be controlled and managed. This is precisely what the Acts of Union aimed to achieve. In effect, a perception was beginning to emerge in Britain that the Ascendency had failed in their duty to make their estates profitable in Ireland, and the Establishment needed to take a substantially firmer hand in the government of the country (Bartlett 2010, 295). This was to be achieved through the Acts of Union. The immediate impact of the Union was virtually negligible: the long-term impacts were profound (Ó Tuathaigh 1990, 36). In particular, the unresolved grievances of the large numbers of Catholics, particularly in terms of landownership, rents, and tithes, became greater and more intense after the Union, with the faults and problems increasingly being landed squarely at the door of Britain (Connolly 1992; Ó Tuathaigh 1990).

While estates of absentee landlords in particular may have suffered at the hands of uncontrolled tenant landlords and baliffs, there were certainly considerable numbers of the Ascendency who were responsible for numerous improvements and advances in terms of agriculture, as well as industry (Breen 2007). Many of the landowners took the duty-of-care towards their estates very seriously and substantial programs of land reclamations and road-building were undertaken. In the nineteenth century the government continued with attempts to encourage Ireland to match Britain's economy with the establishment of the Irish Board of Works (to build a public infrastructure) and the National Education system (to provide education) (Gray 1993b, 89). It may be suggested that the latter was an attempt to gain control over the education of Catholics, which had increasingly been implemented through the illegal hedge-schools that had been set up in contradiction to the penal laws (Akenson 1970). Public works, that were established to provide relief to the starving during the famine of 1822 (food was only provided to the destitute on the condition that they worked for it), were continued right up until the Great Famine. Using the public works scheme, the government undertook a major programme of road building, deliberately targeting the remote areas of Connemara and the southwest. The intention was to minimise the remoteness of areas, increasing communications and trade and, therefore, minimising the impact and/or severity of famine (Daly 1995, 124-5). Undoubtedly, it also had strategic undertones, with the result being the increased mobility of troops and of government control. An estimated £2 million was spent on infrastructural construction in Ireland between 1817 and the eve of the Great Famine (Daly 1995, 125). This was also the era of the construction of some of the great civic buildings such as the Custom House (completed 1791) and the Four Courts (completed 1796) (Brown et al. 1999), as well as many of the elegant thoroughfares of Georgian Dublin, Cork, and Limerick.

The latter part of the eighteenth century saw significant economic growth in Ireland, and particularly at the start of the nineteenth century in association with the Napoleonic wars. As the decades passed Ireland became progressively more important to Britain in terms of the supply of agricultural and industrial goods, particularly as the British empire grew in size (Ó Tuathaigh 1990, 2). Ireland's 'industrial revolution' was limited, and largely confined to linen, brewing and distilling. It certainly could not be compared to the great Victorian industrial factories of Britain. The lack of industry was to have devastating consequences in the mid-nineteenth century when the lack of waged work contributed significantly to the problems caused by the potato blight (Mokyr 1983, 276). Ireland's greatest resource was the land itself (Ó Tuathaigh 1990, 127). From the late eighteenth century through to the mid-nineteenth century there were marked increases in tillage, pig and sheep farming, and in dairying, particularly in butter production (Ó Tuathaigh 1990, 127-8). Ireland initially provided to the British colonies abroad, for example salt beef and butter to the Caribbean (Higgins 2010, 13). As the Americas began to provide for themselves, so Ireland's exports to Britain became more important, particularly in terms of provisioning the considerable army and navy, as well as the industrial masses. For example, the export of sailcloth to the British navy became a very important industry in Cork, particularly during the Napoleonic wars (ibid.; Rynne 2006). The eighteenth century butter market in Cork city was to become the largest in the world by 1800. Other important exports included both raw and processed wool and processed cotton, while the fruits of brewing and distilling also featured significantly (Rynne 2006). Under the Acts of Union Ireland and Britain were to be a single free-trade area. However, it was agreed that Irish industries would take time to adjust and compete fairly with British products, and so a 10% duty was applied to certain imports such as furniture, glass, leather, cotton, and wool (Ó Tuathaigh 1990, 118). This certainly encouraged industry, though problems emerged later (see below). As mentioned earlier, Catholic merchants, unhindered by the Penal Laws, became increasingly important, along with their Protestant counterparts. The eighteenth and nineteenth centuries saw the emergence of a true capitalist economy, with a new, more global, commercial spirit of enterprise and innovation, in contrast to the feudal economy of the earlier centuries (Gillespie 2009; Murphy 2003; Smyth 2006). This increase in industry, and particularly in agricultural trade, encouraged the growth of a middleclass, or classes, who were not defined by status such as the landowning Ascendency, but by modern economic enterprise. By the mid-eighteenth century 'metropolitan standards of behaviour' were already spreading through the country (Connolly 1992, 314).

By the 1800s Ireland and Britain, now united under the Acts of Union, shared a number of similarities. These included rapid population expansion, similar weather patterns, and similar exposure to 'shocks to supply' brought about by disruption to international trade and high taxes (Ó Gráda and Mokyr 2006b, 25). However, this is where the similarities ended. Despite the apparent prosperity in terms of agriculture and certain industry, serious problems were developing in Ireland by the nineteenth century. Ireland ultimately failed to contend with Britain in terms of industry due particularly to the lack of the basic and crucial raw materials of nineteenth century industry, that of iron and coal (Ó Tuathaigh 1990, 120). The scale of industrial development was limited, despite the undisputed success of certain industries such as linen in the northeast (Rynne 2006). As mentioned above, many Irish industries were supported at the beginning of the nineteenth century by tariffs on British imports. Unfortunately, to a certain degree, this did not encourage the Irish industries to improve their technologies when advances came, and there was a certain level of stagnation (Ó Tuathaigh 1990, 117). Certain industries were also lulled into a false sense of security by the demands of provisions to support Britain during the Napoleonic Wars. Those wars ended in 1815 and economic depression followed (Ryan 2000). The tariffs, that were originally set to encourage the development of Irish industries, were abolished in 1824. This was a death-knell for many Irish industries, which simply could not complete with the cheaper British products that soon flooded the Irish markets. When large-scale industry first began to be developed in Ireland the traditional cottage industries, such as weaving, began to decline, frequently depriving women in particular, of an income. Essentially Ireland sacrificed her cottage industries, the mainstay of the poor, to try and compete with the British industrial revolution, a competition that was one-sided from the outset.

The lack of industrial work with real wages in Ireland, in a time of a burgeoning modern economic world, was to have significant effects. A significant proportion of Ireland's population remained in employment in agriculture in comparison to Britain. It has been estimated that in 1841 Ireland had an agricultural population density of 213 people per 100 hectare of arable land, compared with a density of 65 people in England and Wales (Grigg 1980, 121). In fact, almost three-quarters of males (74.3%) in Ireland were directly engaged in agriculture in 1841 (Kennedy et al. 1999, 146). Those individuals primarily comprised small farmers, labourers, and cottiers, not the landowning class. When agricultural shocks came, such as the economic depression after 1815, there were few options of waged industrial work for unemployed farmers and labourers. In addition, as mentioned above, the traditional cottage industries had earlier been sacrificed in the attempt to develop industrial Ireland. Thus these safety measures were also gone by the nineteenth century, a time of increasing agricultural change.

3.3 Stress On The People

It is apparent that the inherent structure of Irish society changed dramatically from the sixteenth through to the nineteenth century, gradually becoming more polarised into a small elite landowning group, the Ascendency, and a majority of small farmers, cottiers, and landless labourers. As the economy began to develop and modernise, there increasingly developed classes of larger farmers, as well as merchant and business classes. However, until the mid-nineteenth century the cottiers and the labourers accounted for the largest, and most vulnerable, proportion of the population. The changes outlined in **Section 3.2**, were matched with considerable social upheavals, often resulting in food shortages, including famine, and disease outbreaks. Certainly, the severity of these instances varied considerably over the period, but conditions in the mid-nineteenth century ensured that the Great Famine of 1845-52 would act as a watershed and a catalyst in the history of Ireland. Linked in with the prevalence of famine and disease in the post-medieval period was the diet of the people. Diet changed dramatically over the period. In the beginning it was largely limited to certain foodstuffs, but was quite adequate, as long as access to the foods was maintained. By the nineteenth century, Ireland was producing a wide variety of foods. In addition a large variety of products were being imported, particularly from British colonies abroad, including exotic new foodstuffs such as sugarcane, from the New World. However, the diet of the main population became increasingly focused, particularly on the potato, and eventually became a reflection of the significant class divides in Irish society. It was in this period in particular that the potato began to be cultivated in every scrap of land available (Ó Tuathaigh 1990; Whelan 1995b).

Perhaps most significantly, Ireland in the eighteenth and nineteenth century saw a considerable growth in population. It has been estimated that in 1750 the population of Ireland was approximately 2.5 million people. Within 40 years it had almost doubled, and, in less than one hundred years, in 1841 the population had reached 8.2 million (Brown 1991, 225). Essentially, in just 100 years the population grew by 240% (Kennedy et al. 1999, 76). There were a number of reasons for the population increase. These included a fall in death-rates, a rise in birth-rates, and a reduction in some of the main epidemic diseases, such as smallpox (Grigg 1980, 117-121; Ó Tuathaigh 1990, 5-6). The growth was most pronounced in the poorest areas in the west of the country and in the non-landowning classes of cottiers and labourers (Connolly 1992, 315; Ó Tuathaigh 1990, 118, 130; Whelan

1995b). It may be interpreted that the country had reached its carrying capacity, and a Malthusian-control was inevitable (Pilcher 2006, 47). In reality, Ireland was not as densely populated as some contemporary continental countries (ibid.). However, the growth did insure that there were increasing numbers of people exposed to fluctuations in the market economy (Connolly 1992, 315). In addition, the population growth was greatest in the lower classes who, by the dawn of the nineteenth century, relied entirely on the potato for sustenance.

The increase in population in the lower classes was closely tied with the type of agricultural practice. Tillage became increasingly more common in the latter half of the eighteenth century, and was specifically tied to the availability of a large pool of cheap labour, as well as to market demand. The success of tillage crops also depended on a good crop-rotation system, which was ultimately achieved with the cultivation of the potato, where the potato was used both as a ground-clearer and as a crop to return fertility to the soil after cereal growing (Clarkson and Crawford 2001, 62). Thus population increase was 'both a condition and a consequence' of agricultural expansion (Ó Tuathaigh 1990, 129). Cottiers held less than 5 acres, while labourers took work wherever they could for either wages or payment in kind and typically had access to a tiny plot of land averaging one acre (Brown 1991, 225; Ó Murchadha 2011, 6). The latter two categories were especially open to exploitation by whoever they rented the land from, be it actual landlord, agent, or large famer, as they had virtually no protection in terms of leases (Ó Murchadha 2011, 6). Small farmers were classed as those who held land of between 5 and 15 acres. By 1845 the labourers and cottiers outnumbered the small farmers by two to one (Brown 1991, 225). It is estimated that the cottiers accounted for approximately 300,000 households, while the labourers occupied twice that many households (Ó Murchadha 2011, 5). The changes in agriculture and industry, and the increase in population, all particularly occurring in the eighteenth century, changed the fundamental structure of rural society. The practice of sub-dividing the land grew exponentially, resulting in an enormous increase in the cottiers and labourers. As the Irish economy developed along Ireland's evolving link with Britain, so Ireland became progressively more exposed to external shocks and economic modifications (Mokyr 1983, 279; Ó Tuathaigh 1990, 132).

Although there were periods of economic depression, food shortages, and disease outbreaks right up to the Great Famine, essentially Ireland was relatively prosperous, as least in terms of the landed classes. In reality, the level of poverty in the country also increased dramatically in the lower classes (Ó Tuathaigh 1990, 6-7). The poor, who were increasing in terms of population size, were getting progressively poorer, being reliant on an agricultural system that encouraged subsistence existence on a single crop, the potato (Ó Gráda and Mokyr 2006b). Crucially, the British government refused to address the land system, which was a major contributing factor to the massive poverty (Ó Tuathaigh 1990, 114). Thus significant numbers of people were increasingly exposed to stresses in the eighteenth and nineteenth centuries, culminating with the Great Famine.

Early nineteenth century society depended on two basic factors: 'the continued high price-level of tillage crops, and also the continued health of the potato crop' (Ó Tuathaigh 1990, 135). The former ceased after 1815 with the end of the Napoleonic wars, while the volatility of the latter had already become apparent with sporadic checks on the availability of the potato to the poor (see **Section 3.3** below). Agricultural prices, particularly for tillage, dropped significantly after 1815. This undoubtedly put real and significant pressure on all classes of society, but the pressure would have been greatest on the lower ranks, with small farmers unable to pay high rents, and landlords and large farmers became reluctant to rent out valuable farm land as subsistence plots to cottiers and labourers (Ó Tuathaigh 1990). In response to the new economic situation, Ireland dramatically increased land under pasture, to facilitate in particular the growing export market of livestock (Kennedy et al. 1999, 176ff). As a result, evictions became more common and agrarian violence became endemic (Bartlett 2010, 199; Ryan 2000).

The levels of poverty and destitution rose exponentially. Waged work is typically used as a measure of quality of life, but such work played a small role in the Ireland of the eighteenth and early nineteenth century (Mokyr and Ó Gráda 1988). However, census data provides information on the quality and quantity of housing in the country on the eve of the Great Famine. As noted earlier in Chapter 2, in 1841 between 37-40% of the houses comprised one-roomed, windowless, mud cabins, an indication of the numbers that lived in abject poverty (Ó Tuathaigh 1990, 148; Ó Gráda and Mokyr 2006a, 80). There were, of course, regional differences. For example the barony of Ross in west county Galway had 80% fourth-class houses, while in Cork city just 3% were classed as such (Kennedy et al. 1999, 76). Of course the latter does not account for the slum tenements that became such a feature of many Irish cities in the nineteenth century. The horrendous conditions of these tenements have been well-documented (Johnson 2002, 7-10; Prunty 1998; Prunty 2004). The urban conditions have been referred to as 'slum cancer' (Ó Tuathaigh 1990, 155). The

Times newspaper, referred to the slums in Dublin in 1805 as 'the worst in the kingdom', despite the infamous urban conditions in the industrial cities of Britain (O'Connell 2007, 3). The early figure, based on the types of rural houses, truly mask the urban realities. It has been estimated that in 1841 just over 72% of families in Cork city were living in slums (Murphy 1980, 27, quoted in ; O'Brien 2002, 335).

Edmund Burke (1729-1797), the Irish statesman, provides a description of the everyday lives of the cottiers and labourers, which undoubtedly was mirrored in the nineteenth century also:

> 'As for their food, it is notorious that they seldom taste bread or meat; their diet in summer is potatoes and sour milk; in winter they are still worse - living on the same root, only made palatable by a little salt accompanied by water. Their clothing so ragged that they rather publish than conceal the wretchedness it is meant to hide. Nay it is no uncommon sight to see half a dozen children run quite naked out of a cabin scarcely distinguishable from a dunghill. You enter one of these cabins, or rather creep into it, at a door of hurdles plastered with dirt; within you will see (if the smoke will permit you) the men, women, children, dogs, and swine lying. Their furniture is much fitter to be lamented than described, such as a pot, a stool, a few wooden vessels, and broken bottles. In this manner all the peasantry to a man live' (quoted in O'Connor 1995, 99).

The deterioration in living conditions of the poor, along with the rise in their numbers, was a matter of concern for the authorities. Poverty had become a major issue in industrial Britain and there was an increasing concern at government level that the issue needed to be seriously addressed. The horrendous conditions of the Victorian urban poor in Britain had already become immortalised in the writings of popular authors, most famously those of Charles Dickens. In Ireland there certainly was a perception of a deterioration in living conditions of the poor at least between 1815 and 1835, based on responses to specific questions by the Poor Inquiry Commissioners in the 1830s (Ó Gráda and Mokyr 2006b). In 1842 Edwin Chadwick's famous 'Report on the Sanitary Conditions of the Labouring Population of Great Britain', was published, and was seminal in its thesis that disease caused poverty and vice versa (Haines 2004, 257). It was unrelenting in its assessment of the conditions of the poor. When the Irish are referenced in the text, it is typically in terms of surprise and/or concern at either their living habits, even in contrast to the native poor of Britain, or to their treatment of the dead (Chadwick 1843). Irish immigrants in Britain were frequently referenced by social commentators such as Friedrich Engels and J. B. Priestley for their appalling living conditions, which were considered as part of the Irish condition (Ward 2004, 117).

Despite the poverty and the lack of real wages, the Irish rural poor may have been more fortunate than their counterparts in the confines of the industrial urban centres of Britain in particular. As will be referred to below (**Section 3.3.1**), the diet of the Irish poor was quite nutritious and, when it could be sustained, was quite adequate for survival. The typical house of the poor, which comprised a one-roomed, windowless, mud cabin, could easily be constructed and was cheap. In addition, fuel (turf) was plentiful and cheap. Thus the basics for survival – food, shelter, and heat – were readily available to most. However, circumstances beyond the control of the poor ensured that this balance was progressively interrupted, culminating with the Great Famine.

Even before the Great Famine there were numerous and devastating disease outbreaks throughout Ireland including typhus and cholera (Robins 1995). In addition there were at least twenty-four failures in the staple crop between the 1720s and the 1850s (O'Connor 1995). By the 1830s the cumulative effect of minor potato failures, disease epidemics, and chronic unemployment due to surplus labour and industrial decline had become significant issues. A debilitating cycle of famine and disease had become well established (Geary 1995, 81). In contrast, assessments of tea, sugar, and tobacco consumption in the same period suggest a positive trend in living conditions in the middle and upper classes, in the same period (Ó Gráda and Mokyr 2006b). The 'well-to-do' farmer was declining by the nineteenth century, while there was a corresponding increase in the numbers of people who could no longer afford the supplementary foods to the staple potato (Mokyr 1983, 12).

3.3.1 The Post-Medieval Diet

The evidence of diet and nutrition prior to 1800 is quite limited (Clarkson and Crawford 2001, 1979). The medieval diet mainly comprised butter, milk, and grain products (Whelan 1995b, 19). At the end of the medieval period diet in Ireland essentially fell into two broad spectrums: a diet centred on animals and their by-products, and a diet based on pulses and cereals. The former was particularly prevalent in the traditional Gaelic areas, while the latter tended to occur more in the areas of Anglo-Norman colonisation (Dickson 1997).

Animal-related foods included meat, milk, cheese, and eggs. In terms of cereals, barley, wheat, and rye were primarily grown and most went for export. Oats were also widely grown. Oatmeal, which was considered a poorman's food, was consumed in a variety of ways. The favoured version was porridge, although it was also made into cakes, dumplings, and sowans (crushed oats steeped in water). Flummery – a mixture of grain chaff and boiled water – was also common (Clarkson and Crawford 2001, 78). Fish, especially herring, were consumed in the coastal area though, for a variety of reasons, this resource always remained underutilised, even during famine times. With the expansion of European powers into overseas colonies at the start of the post-medieval period, diets gradually became more varied, with foodstuffs increasingly being traded between continents. By the start of the nineteenth century the middle and upper classes diet was varied and included grains, meat, dairy, fish, fruit, vegetables, wines and spirits, with the added luxury of groceries such as coffee and sugar. Tea and white bread remained as luxuries in Ireland until well into the mid-nineteenth century (Mahon 1991, 39). In contrast the labourers and cottiers, which formed the largest proportion of the population, gradually became reliant on a diet of potatoes and buttermilk (Crawford 1995, 62; Clarkson and Crawford 2001, 29). The diet of the small-farmer may have been broadened out with wholemilk, oatmeal, and wheaten bread (Ó Tuathaigh 1990, 149). While agricultural produce, and indeed imports, was quite diverse, the poor had largely come to entirely rely on potatoes for their nutrition (Mokyr 1983, 262).

The potato is inextricably associated with the eighteenth and nineteenth centuries in Ireland. From an exotic garden crop in the sixteenth century, the 'humble potato' came to be the subsistence food for a huge proportion of the Irish population as it did elsewhere in Europe. Unlike the situation elsewhere however, on the eve of the Great Famine the potato was the only food for about one-third of the Irish population, and played a major role in the diets of many more (Ó Tuathaigh 1990, 203; Póirtéir 1995b, 9). Evidence suggests that the potato first came to prominence in the south of the country, particularly in Munster, and was initially associated with the newly settled English (Dickson 1997). When the potato was first introduced to Ireland in the sixteenth century it was a novel garden supplement. By the third quarter of the seventeenth century it became popular as a winter food for the poor, to supplement the spring/summer diet reliant on oats (Bourke 1993; Dickson 1997, 11). It also increasingly cushioned the poor during times of bad grain harvests (Dickson 1995, 53). In 1681 the Englishman Thomas Dinley, who documented his travels around Ireland, wrote the 'diet of vulgar Irish is potatoes, new milk, whey, curds and a large brown oatcake a foot and a half broad, baked before an open fire' (Mahon 1991, 73). The potato became increasingly used to clear the ground for tillage crops, as well as restoring nutrients to the soil. Its potential as a food source was not missed. In a study of the usage of the potato in pre-famine Ireland it has been found that 47% was for human consumption, 33% as animal food, 13% for seed, 5% was wastage, and just 2% was exported, the latter being a reflection of how unsuitable the crop was for export, due to its bulk (Bourke 1968, 93). A diet of potatoes is actually quite nutritious (Clarkson and Crawford 2001, 74; Dickson 1997, 12). Potatoes lack Vitamins A and D, but these could be obtained through the consumption of milk and herrings (Clarkson and Crawford 2001, 74). Interestingly, despite the high quantities of potatoes consumed by the poor by the nineteenth century, those who depended primarily on the potato may often have felt hungry, even when there was no shortage of potatoes. This relates to the fact that potato is low in fat and fats in the diet 'give satiety value' (Clarkson and Crawford 2001, 184).

The use of the potato as a crop associated with tillage ensured it become widely grown, while its cheapness, ease of cultivation, and nutritional value ensured it became more common as a food among the poor. From 1750 onwards the potato formed the full-year staple for small farmers, labourers, and cottiers, and virtually replaced grains in the diet (Bourke 1993). In line with the massive increase in population among the poorest classes, which was invariably concentrated in the poorest areas of the west, previously unoccupied land was honed for the cultivation of potatoes (Connolly 1992, 315; Whelan 1995b; Ó Tuathaigh 1990, 118). The lazy-beds of potato cultivation became an intrinsic part of the remote rural landscape and are still apparent in even the most isolated of locations today (Crowley et al. 2012a).

It is somewhat difficult for the modern observer to understand the extent to which potatoes took over the diets of the poor. On the eve of the Great Famine some three million labourers and cottiers, the 'potato people', depended solely on the potato (and buttermilk) for sustenance (Clarkson and Crawford 2001, 30). The increasing prevalence of potatoes in the diet of the poor is starkly evident in the estimate consumption levels per person per day. In the 1740s the daily consumption has been calculated as 2.25lbs. By the 1770s this had risen to 6.5lbs, and in the first half of the nineteenth century it had risen to an average of 12.5lbs (Clarkson and Crawford 2001, 63, 64, 73). Those who depended on the potato invariably complemented it with buttermilk. The emergence of buttermilk or *bainne clabair* ('bonnyclabber') was inextricably linked with the general economic growth in the period and specifically the massive increase in butter production (Dickson 1997). Butter exports became considerable in the eighteenth and nineteenth century and were particularly based in Cork (Rynne 2006, 190). Buttermilk is a bi-product of the manufacturing of butter and, as it could not be exported, it increasingly formed an important element in the diet.

In Europe the potato was the food of the lower classes and a common fodder food (Baten 2009, 169). But in Ireland the potato was not simply the mainstay of the lower classes. By the 1820s the potato was common throughout every class (Clarkson and Crawford 2002). Oatmeal only remained popular in Ulster in particular (Whelan 1995b; Bourke 1968). In the rest of Ireland, the utilisation of other foods was virtually forgotten, including baking breads, curing fish and meat, and making cheese (Mahon 1991, 6, 109). Many of the traditional grain mills had gone out of use by the middle of the nineteenth century. This was to have significant repercussions during the Great Famine. Of course, it is unlikely that every single poor individual existed exclusively on potatoes and milk. There could be variations, were individuals may have had access to other foodstuffs. Particularly, domestic servants may have had access to more variable foods through their employment than other individuals (Mahon 1991, 7). In 1841 just 3% of males were employed in domestic service. In contrast almost a quarter of females (23.7%) were similarly employed (Kennedy et al. 1999, 146). It is unlikely however that factors such as this would have made substantial differences to the diets of most of the population.

3.3.2 Famine and Disease

Famine and disease were common occurrences in early modern Ireland. Famine conditions were reported in Ireland as recently as the 1920s, at which stage the actual term 'famine' was rigorously rejected by the fledgling Irish government in favour of less emotive words (O'Neill 1995). Disease and famine, while they could, and can occur, as separate unrelated events at any time, frequently occurred together in the past, particularly in times of social upheaval. Thus they were common during the turbulent sixteenth and seventeenth centuries in Ireland, when wars and civil strife, accompanied by large-scale land clearances (see **Section 3.2**), ensured that conditions were ripe for outbreaks of famine and disease (Breen 2009; Edwards et al. 2007). Unfortunately, there are few reliable sources documenting these occurrences of famine and disease, particularly as many of the recorders were English, and were not predisposed to being sympathetic to the dispossessed Irish (MacLysaght 1979).

The modern perception in the Western world of disease and famine is probably far removed from reality that was the experience for most of the human race prior to modern scientific advances. The advent of modern medicine, the obliteration of actual famine and most of the epidemic diseases, and the advent of the modern welfare state, that in effect has a duty of care towards the poor today, has ensured that most in modern Ireland can never comprehend the conditions endured by people living just perhaps 150 years ago. Reports on modern famines, such as that in Ethiopia in the 1980s, and the horror-invoking threats of rampant disease that follow cataclysmic events such as tsunamis in foreign climes, act as stark reminders to how easily human society may be decimated. While there are certainly reports of food shortages in modern Ireland, particularly in the most recent recession (Healy 2012), in reality, there can be no resemblance between those shortages and the abject hunger and poverty experienced in Ireland throughout the numerous famines in the post-medieval period, and particularly in the eighteenth and nineteenth centuries. Similarly, most of the diseases in Ireland today are diseases typically associated with modern civilisation and affluence, such as heart disease (Eaton and Eaton 1999). They are not the rampant infectious diseases, such as smallpox and cholera, which wiped out countless individuals in the era before modern medicines, and for which there were no cures until relatively recently. Only one disease still appears to evoke genuine fear in the modern Western world, and that is tuberculosis (O'Regan 2010). The recent outbreak of TB in a school in Cork (Shanahan 2010) confirm this fear, although the common belief that TB is making a significant resurgence in Ireland may be largely unfounded (Pringle 2009). Invariably, in a modern context, the actual events of food shortages, famines, or disease epidemics are far removed from our awareness. However, earlier populations of Ireland were all too familiar with them.

Typically it is a combination of natural disasters and disease epidemics, and the actions of human that can cause the most suffering. Each may occur independently of each other, but when they combine the effects may be considerable, not only in terms of death-tolls but also in terms of the disruption to, and possible destruction of, elements such as the social and economic structure of society that may have resonances for generations afterwards. Certain periods of history also appear to have been 'crisis-prone', where the accumulation of these factors claimed countless numbers of lives, such as was the case in mid-seventeenth century Ireland (Dickson 1995). The plague and famine of 1647-51 were associated with the latter stages of Confederate wars and the Cromwellian reconquest and the combination of war, plague and famine collided to decimate the population. Interestingly, it has been postulated that famine-like conditions may have been deliberately created to subjugate the native population in Munster in the 1580s and 1590s (Breen 2009), clearly a reflection of how human processes may either bring about or control famine in particular.

Uncontrolled circumstances often served as the catalyst to devastation. In the late 1720s there was a series of failed grain harvests, which resulted in significant hardships and famine conditions, particularly in Dublin and Ulster. In contrast, the southern half of the country was not as badly affected because of the growing dependence on the potato (Dickson 1997). Indian meal was distributed to the distressed in the years of the Great Famine, although it had been used in times of food shortages from 1800 (Crawford 1995, 62). The first real indication that the growing reliance on the potato was a dangerous gamble occurred when on the 27th December 1739 temperatures in Ireland fell well below freezing and essentially stayed that way for the next seven weeks (Dickson 1995). Abnormal weather conditions continued until at least the winter of 1741. The period between 1740-41, became known as *Bliain an Áir* or 'The Year of Carnage', when the potatoes both in the ground and in storage, and which was just beginning to infiltrate as the subsistence food of the majority of the population, were destroyed by freezing temperatures (Ó Gráda 2006b, 198; Dickson 1997). In relative terms, it was as severe as, if not worse than, the later Great Famine of 1845-52, although the long-term consequences of the latter were considerably more significant (Dickson 1995, 55; Ó Gráda 2012a). In 1816-17 famine again became widespread throughout Europe due to adverse weather conditions linked with a volcanic explosion in the Indian Ocean (Daly 1995, 123). Food shortages were not unusual. In the decades preceding the Great Famine, famine conditions were reported in 1822, 1831, 1835, 1837, 1839, and 1842 (Daly 1995, 125). Most were relatively small and/or localised incidences of food shortages. The ferocity of the 1740-41 famine, and indeed the ten other major famines over the previous 500 years, have been eclipsed by the Great Famine of 1845-52 (Dickson 1995).

Disease outbreaks are often expressly linked with famine. This is not only related to the fact that undernourished or malnourished individuals will have a lower immunity threshold than individuals who are properly nourished, but also to the general disruption to social norms that typically accompany famine. For many centuries disease, and indeed famine, were seen as punishments by God. During the cholera epidemic of 1832-4 the Catholic Archbishop of Dublin, Bishop Murray, sent a pastoral letter to his diocese. In it he states: 'you have disregarded the warnings of the word of God…your sins have ascended to the throne of the Lord and demanded justice' (Wood 1991; Murray 1832, 434). Disease was very poorly understood until well into the nineteenth century (Robins 1995). In reality, there was little that doctors could do prior to modern medicines, and care largely involved efforts to minimise the ravages of disease. As will be shown in **Section 3.4**, the loss of the potato crop for those at subsistence level in the mid-nineteenth century, combined with both evictions and a general search for food, ensured that a veritable army of paupers wandered the land, particularly drawn to urban areas, as well as the newly-founded Poor Law Union workhouses. The increase in pauperism, added to the mass-movement of people, with the resulting overcrowding in the aforementioned environs, and the general reduction in hygiene, ensured the easy spread of pathogens. There was a major fever epidemic in 1817-19, which was associated with famine conditions (Geary 1995). Ireland suffered a pandemic of cholera in 1848-9, but its appearance was coincidental (Geary 1995, 81). Yet the conditions resulting from the widespread loss of the subsistence crop ensured that it spread rapidly. Fever also was intimately linked with food shortages. This relationship was established long before the Great Famine. In fact, the two occurred in all but two decades of the eighteenth century (Geary 1995, 77). A major fever epidemic in the last decade of the eighteenth century, was 'fuelled by climatic extremes, poor harvests, and rising food prices' (Geary 1996a, 77-8).

In the early part of the nineteenth century, as the levels of poverty and distress in Ireland became more frequent, so the British government came under increasing pressure to deal with the situation. The solution came in the form of the Irish Poor Law Act of 1838.

3.3.3 Poor Law Union Workhouses

The growth in population in the poor classes, their increasing reliance on the potato for sustenance, and the lack of waged work, ensured that poverty was a problem for a large part of the population who were particularly vulnerable to shocks to the delicate balance of existence. Hence there were large numbers of reports of food shortages, famines, and disease epidemics long before the Great Famine (see **Section 3.3.2**). Poverty has been identified by some as '…the greatest social problem of pre-famine Ireland' (Ó Tuathaigh

1990, 108). Unlike Britain, Ireland, by the nineteenth century, had no Poor Law (Kinealy 2012). In effect, the poor were assisted though charitable religious foundations and through the initiatives of some local authorities (ibid.). There were increasingly large numbers of poor who, in times of distress, sought the only avenue of help, which was outdoor relief. This was the traditional favoured system of relief in Ireland. The attitude of the governing elite to the poor and destitute changed dramatically in the time period in question. Little was afforded them in the sixteenth and seventeenth centuries. It was only once society in Ireland and Britain began to stabilise, with less warfare (at least on native land) and more economic development, that any serious type of responsibility towards the poorer in the community began to emerge. In the eighteenth and nineteenth centuries attitudes to the poor changed, and at least some level of a 'duty of care' was evident. Publicly funded county workhouses, the so-called 'Houses of Industry', were established in the 1770s (Dickson 1995, 58). This relief of those in poverty however was deeply imbued with the attitude that the poor, and particularly the able-bodied poor, were to blame for their own state. This attitude persisted right into the twentieth century.

An extensive report was compiled by a Royal Commission in 1833. The commissioners found that almost 2.5 million people lived in poverty, with many being particularly vulnerable in the summer months, the end of the potato season (Kinealy 1997, 39). They concluded that an outdoor relief system was one of the most appropriate ways to deal with the destitute in Ireland, as their state was primarily caused by the lack of employment (Crossman 2006a, 8). A programme of assisted emigration was also recommended (Kinealy 1997, 39). However, this report was vehemently ignored by the British government in favour of a report by George Nicholls, an English Poor Law Commissioner, who found in support of the workhouse solution (Kinealy 1995, 104-5; Ó Tuathaigh 1990, 111-2). Nicholls's report took six weeks to compile, in comparison to the three years the Commission had spent assessing the poor of Ireland (Lonergan 1992). In addition, Nicholls's report specifically examined destitution rather than just poverty. As such, he found that the numbers of individuals at risk totalled just 100,000 (Kinealy 1997, 39). The relief system in Britain, of confining the destitute poor in institutions, namely workhouses, was adopted. It was based on the 1834 Poor Law Amendment Act. The method of relief was specifically designed to make the 'lazy and idle' seek employment rather than enter the workhouse (O'Connor 1995, 4). Essentially the system of poor relief from one of the richest and most advanced countries in Europe was transposed on one of the least developed countries (Kinealy 1995, 105).

There was both great support of, and significant opposition to, the Poor Law Act of 1838, the first of its kind in Ireland (Ó Tuathaigh 1990, 109-10). Daniel O'Connell, initially a vehement opponent to the 1838 Act, claimed it further demoralised the poor and went against the traditional system of alms-giving in Irish society (Ó Tuathaigh 1990, 110). In addition, it has been argued that the Irish Poor Law Act of 1838 was actually harsher towards individuals than its equivalent in Britain, because of the belief that a more liberal system would drain Ireland's resources (Kinealy 1995, 106). In contrast to Britain, there was no right to relief, there was no provision for outdoor relief (the traditional system in Ireland), and there was no law of settlement, which related to the habitation and the responsibility of a parish towards its poor (Kinealy 2012, 88). The workhouses were deliberately designed, through their physical structure and harsh regimes, to discourage individuals from going in through 'a monotonous diet, enforced labour, and strict regimentation, classification and segregation' (Kinealy 1995, 106). In the Victorian era, 'what was seen as adequate for the poor in terms of clothing and housing, for example, bore no relation to what was regarded as minimum standard higher up the social scale' (Crossman 2010, 137). In effect, the poor were considered by 'polite' society as a lesser order of human, and as such a degrading, dehumanizing life was perfectly acceptable for the poor (Marcus 1985, 109). The workhouses were universally established in Ireland in the 1840s. It allowed the creation of a regional network of workhouses based on amalgamations of electoral divisions that were grouped into what were termed Poor Law Unions, of which there were 130. These were later increased to 163 Unions (Ó Tuathaigh 1990, 215-216). Each Union was to construct a workhouse, to house the destitute in that Union. It replaced the old parochial outdoor relief system with the workhouse system. Each Union was to be self-supporting.

Workhouses were built to one of three standard plans, all designed by the architect George Wilkinson (see **Figure 3.1**). Small workhouses were to cater for between 200-300 people, medium-sized workhouses were designed to hold 400-600 people, while the largest of the workhouses could hold 1000 people or more (O'Connor 1995, 80). All workhouses followed a set design:

> 'There was a small entrance block, known as the workhouse administration unit, which housed the board-room and offices. Passing through this block one came to the main institution, usually a transverse three-storey building of stone. This block contained the workmaster's office and several wards, usually

for ambulant inmates. At the rere [*sic*] were the kitchens, wash-houses and store rooms' (O'Connor 1995, 81).

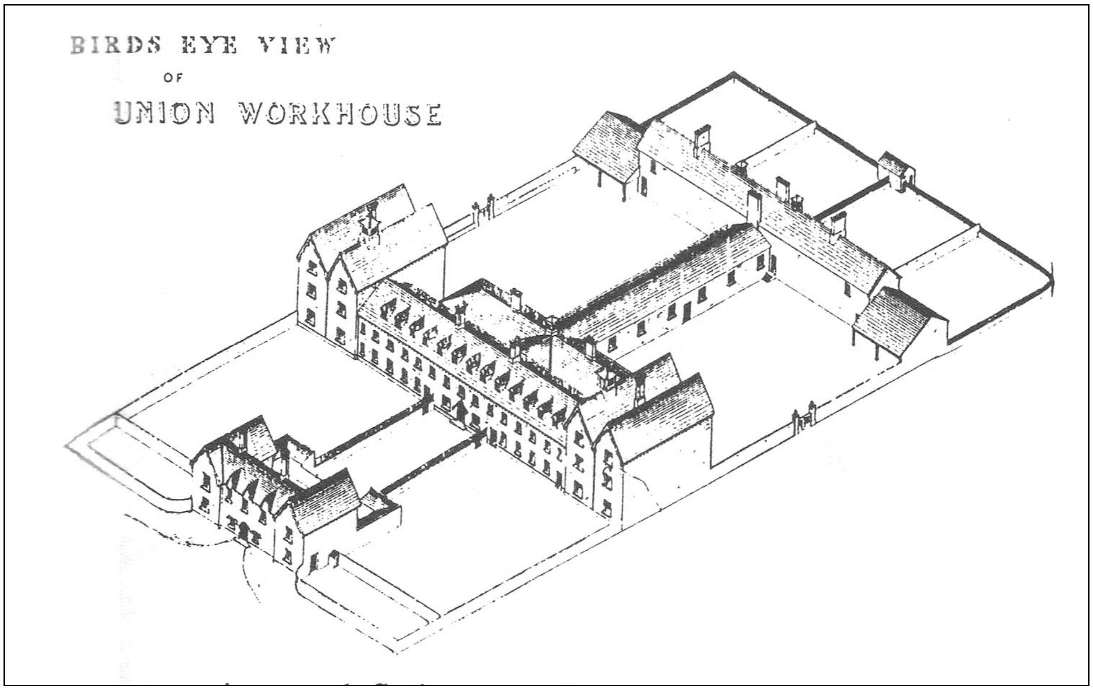


Figure 3.1.
Standard plan for Irish workhouse, architect George Wilkinson (O'Connor 1995, 81)

In order to gain admission to the workhouse the whole family had to enter, and destitution was a prerequisite. The family were then divided into three groups: female adults over 15 years old and children under 2 years; men aged over 15 years; children aged between 2 years and fifteen years. The divisions were strictly maintained. Uniforms, which in some cases may have been preferable to the rags that many of the poor wore, were allocated, further ensuring the control of the individual (Baugher 2009; Piddock 2001). Each workhouse was governed by a Board of Guardians. These typically comprised a clerk, a treasurer, a medical officer, a master, a matron, a porter, a schoolmaster and schoolmistress, and a chaplain (O'Connor 1995, 95). Diet was to comprise of two meals a day, consisting of eight ounces of stirabout and half a pint of milk for breakfast, and three and a half pounds of potatoes and one pint of skimmed milk for dinner (O'Connor 1995, 101). This was in stark contrast to the estimated 12/13 pounds of potatoes that may have been eaten daily in pre-famine times (see **Section 3.3.1**). Children's diets varied slightly with the addition of bread and new milk (ibid.). Meat did not form part of the diet, and continued to be a common exclusion, as 20 years after the foundation of the workhouses this was still the case. In the Poor Law Commissioners annual report in 1860 it was stated 'the exclusion of meat, cheese, tea and butter, (which are used in the workhouses in England) from the ordinary workhouse dietary in Ireland was due in the first place to the fact that meat was not an ordinary article of food in the diet of the Irish labourer and peasant' (Lonergan 1992).

Inmates were put to work, a combination of both keeping them occupied and thus less likely to engage in inappropriate behaviour, and also partially for the public good. This, along with all aspects of the workhouse, related back to the basic principle of the time: poverty was linked with moral worth, and if paupers were so immoral as to force normal society to support them, then the paupers should be made aware of that fact in every way everyday (Smyth 2012a, 123-124). Work tasks included stone-breaking, grinding corn, and general labouring on the lands and within the institution for males, while women undertook household duties, laundry, clothes repair, as well as manual work including stone-breaking (O'Connor 1995, 102). Children were also expected to work. One of the most punishing works involved the capstan mill, where hundreds of inmates manually rotated a large wheel in order to grind corn. It was invented by Richard Perrott of Cork (ibid.). The mill was worked by either 100 women or men for two hours or five hours respectively, or by 150 girls or 150 boys for one hour or three hours respectively (O'Mahony 2005a, 158). Its monotonous punishing regime was considered so harsh that its use was abandoned after just five years (O'Connor 1995, 102). The punishments for not completing the required daily tasks were harsh. In Cashel workhouse in February 1872, Patrick Bourke was sentenced to two weeks imprisonment for failing to break a prescribed quantity of stone (Lonergan 1992, 125).

In Ireland, as in Scotland, the workhouse was frequently referred to as the poorhouse. In fact, the Irish translation of 'Workhouse' is '*Tig na mBoct*', literally 'House of the Poor' (Lonergan 1992, 183). Typically, those in the workhouses comprised those who were permanently or temporarily destitute, and the infirm. Social outcasts such as unwed mothers and prostitutes would also have been forced into the workhouses. Interestingly, there are accounts of 'low women' deliberately entering the workhouses, for example in Cork city, for the sole purpose of seeing if any of the young girls could be persuaded towards a life of prostitution (O'Mahony 2005a). Some inmates would have lived substantial portions of their lives in the workhouse while others may have been in and out. However, there are certainly accounts that some people used the system almost as a respite (Carew 1995; Lonergan 1992; O'Mahony 2005a; O'Mahony 2005b). In times of want, destitution could be feigned and admission granted to a family while the husband was actually undertaking seasonal work elsewhere. Studies of the extant records do not reveal any pattern relating the location of the workhouse to the number of days of residency (Kinealy 2012, 88). It was during the Great Famine in particular that the workhouses were tested, and they failed miserably (see **Section 3.4**). As a result of widespread hunger, disease, and pauperism, countless individuals, through both voluntary and involuntary destitution, were forced to seek solace within the walls of the institutions. The horrendous conditions that prevailed in the workhouses during the mid-nineteenth century ensured that they developed an infamy where the very word 'workhouse' conjures up images of starvation, disease, horror, and death in even the modern Irish psyche.

After the 1850s the numbers entering workhouses diminished and they took on a role more resembling a hospital, and eventually many came under the management of the religious orders (O'Connor 1995, 180). Invariably the workhouses attracted those that were the most vulnerable. As early as 1843 workhouse infirmaries were allowed to treat victims of fever, even if they were not destitute (Kinealy 1995, 109). In 1862 the Relief of the Destitute Poor in Ireland (Amendment) Act allowed sick individuals who were not destitute to be admitted to the workhouse (Lonergan 1992,115). Previously the non-destitute sick were cared for in the county infirmaries, set up in the eighteenth century (Lonergan 1992, 115). In early 1851 almost 14% of the total workhouse population were registered in the workhouse hospitals. By 1872 that figure had risen to 34% (Luddy 1999, 103). The religious orders played a key role in the development of the workhouses as medical and geriatric institutions. It was the Sisters of Mercy in particular who became associated with the workhouse hospitals, but the Sisters of St John of God and the Sisters of Charity of St Vincent de Paul were also involved in nursing (*ibid*.). The adoption of proper nurses within the workhouse system was a relatively slow and arduous task, starting in 1861, and it was not until the last quarter of the nineteenth century that the religious orders became inextricably linked with the workhouse infirmaries (Luddy 1999, 105). In 1872 the Irish Poor Law Commission was abolished and its duties were given to the newly formed Local Government Board for Ireland (Crossman 2006b, 42). The workhouses continued for a time into the twentieth century when they were frequently interpreted as 'a home for imbeciles, a lying-in hospital for dissolute women, a winter resort for the casual labourer or summer beggar, a lodging-house for tramps and vagrants, as well as a hospital for the sick' (Day 1912, 170).

3.4 The Great Famine 1845-52

In 1845 the potato crop, the subsistence food of millions of Irish, was struck by a devastating blight, a fungal disease called *Phytophythora infestans*. At the time, no-one knew what caused the stinking disease that could cause potatoes to rot overnight. The potato had, at that stage, become the dominant food for at least one-third of the eight million inhabitants (Crawford 1995, 60). While undoubtedly the failure of the crop in 1845 caused some 'distress', it was not catastrophic. Those who relied on the potato had suffered before and could cope relatively well with one partial failure. Chaos began to descend when the blight returned in 1846 and completely wiped out the potato crop. People were forced to eat any surviving seed potatoes, which would normally have been reserved for planting the following year. This ensured that even though the extent of the blight was much less in 1847, few potatoes had been sown, and the 'distress' turned into full scale horror. The year is remembered in Ireland as 'Black '47'. It was also the year in which Britain declared that the famine in Ireland was over. In Ireland people began to resort to the 'classic foods of famine': docks, cresses, nettles, seaweed, and blood from live cattle (Dickson 1997, 14). Cabbages, turnips, and swedes were also consumed, though none could compete with the potato in terms of nutrition (Crawford 1995, 66). In desperation people resorted to eating anything they could, including carrion (Crawford 1995). Allied with the loss of the potatoes was the spread of disease. Ireland suffered a pandemic of cholera in 1848-9, which only added to the abject misery already extant in the country (Geary 1995, 81). Famine conditions persisted until 1852, by which time the typical estimates are that one million had died and one million had emigrated. The pattern of emigration started by the Famine has continued to the present day, albeit with a slight respite during the so-called 'Celtic Tiger' period of the 1990s and early 2000s. The scale of devastation in the Great Famine was nothing short of apocalyptic. It was recorded that in 1849 a total of 1,210,482 people was receiving outdoor relief (an eventual concession to the Poor Law Act). Ten years later this had dropped to just 5,425 (Crossman 2006b, 47). 'The Great Famine brought the age of famines in Ireland to a dramatic, apocalyptic end' (Ó Gráda 2006a, 199).

Clearly the post-medieval Irish population in general was accustomed to food shortages, famine, war, and disease epidemics, as were their European counterparts. However, the Great Famine of 1845-52 looms largest in the memory of the Irish psyche and it is not simply that it the most recent of famines in Irish history. Indeed, the famine of 1740-41 may, proportionally, have claimed more lives than the Great Famine. The real outrage with the Great Famine was that a relatively well-developed province of the richest empire in the world could suffer an catastrophic famine in a time of relative peace and plenty (Dickson 1995, 59). Essentially, it was a classic case of a famine at a time when there was no decline in food output, rather there was a change in entitlements and a failure of distribution (Sen 1982). The real disaster occurred through inadequate distribution systems (ibid.; Ó Gráda 2007, 10). The mid-nineteenth century was one of Dickson's classic crisis-prone periods, when unfortunate coincidences tipped 'times of trial' into 'trend-changing catastrophes' (1995, 51). In particular, the society that endured the Great Famine had, despite abject poverty, greater administrative and economic resources to hand, and were more socially and politically aware than their eighteenth century counterparts. There can be no doubt that the Great Famine was truly apocalyptic and the changes it wrought are clearly shown in an array of recent studies (Crowley et al. 2012a; Kennedy et al. 1999). The after-shocks of the Great Famine still echo through to our own time. The centenary anniversary of the famine was virtually ignored, presumably representative of the trauma that was still extant in the country. It was only with the 150th anniversary that there appeared a deluge of works, and the Irish society finally began to come to terms with the cataclysmic event (Crowley et al. 2012b).

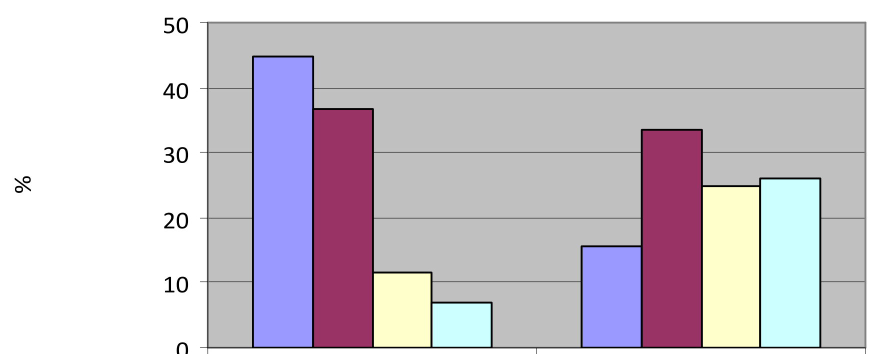
In modern times there have been few famines that match the severity of the Irish Great Famine. In an assessment of some of the major famines in the world since the seventeenth century, it has been found that the Irish famine of 1740-41 had the highest death rate, followed closely by the Great Famine of 1845-52 (Ó Gráda 2012a). Yet, it is the latter famine that has made the greatest long-term impact, particularly in terms of issues such as landownership and emigration. The dominance of the Great Famine is such that it would be difficult to consider Irish history without it (Clarkson and Crawford 2002). The Great Famine also differed in a number of respects to many modern famines (Ó Gráda 2012a, 650-651). In terms of the sheer death toll, only the preceding Irish famine of 1740-41 is comparable, with a 13% death rate calculated for the latter in comparison to a 12% death rate in the Great Famine. Only the Cambodian famine of 1975-79 comes close, with an estimated death rate of 9% (Ó Gráda 2012a, 651-652). In addition, Ireland by the 1840s, was in a relative state of peace, in comparison to the agitation of the previous centuries. Social unrest, particularly wars, is commonly responsible for famine. Crucially also, Ireland was immediately adjacent to the immense wealth of the hub of the British Empire, Britain herself. Indeed, just over 40 years earlier the Acts of Union had firmly tied Ireland and Britain together (see **Section 3.2**). Finally, reaction to the famine was largely a product of the day. Despite the undoubted charitable endeavours of numerous individuals and agencies, the famine was blamed upon the poor themselves, for their abysmal living conditions and lives. It was seen as a deserved punishment for ungodly ways (Ó Gráda 2012a, 650-651).

Perhaps one of the most devastating realities of the Great Famine was, unlike that in 1740-1741, there were adequate supplies of food being produced in Ireland throughout the famine. Only the potato crop was destroyed, cereals were not affected. However, the cottiers and labourers that produced the cereals existed on potatoes, not on grains. The fact that there were cereals being produced in Ireland throughout the famine has been somewhat oversimplified in the popular mind. In reality, imports of cheap grains far exceeded exports of Irish grain (Ó Gráda 2012a, 653). Even at the height of the Great Famine, food was still being produced in Ireland, but most of it, apart from the potato, was destined for export. Imported foods were largely destined for the tables of the large farmers, landowners, and merchants. In any case the country was not lacking in food. It was the mode of distribution that caused the problems (Sen 1982). Most of the most severe famines of the twentieth century were brought about directly by human action, for example the Soviet famine of 1932-3 (Ó Gráda and Mokyr 2006a, 76). While the Great Famine was not deliberately caused by human action, in that it was instigated by the potato blight, the terrible death toll and long-term consequences could have been lessened if different interventions were applied.

Ó Gráda (1995, 256) credits three factors to the devastation that occurred: a backward economy, bad luck, and the ideology of the time. It was the very composition of Irish society at the time that ensured huge numbers were brought to devastation. **Section 3.3** has shown how the numbers of abjectly poor people had increased exponentially in the first half of the nineteenth century, due to a combination of social and economic factors. The labourers and cottiers had emerged to support the labour-intensive tillage agricultural system that had developed. The workers were largely landless and fed almost exclusively on the potato. Despite this, they had shelter, cheap and plentiful fuel in the form of turf, and the potato is one of the most nutritious foods that an individual could consume. However, when the potato failed an horrific cycle soon emerged. Cottiers abandoned their tiny rotten patches of potatoes and they, along with the labourers, sought work on public relief schemes, as there was little waged industrial work available (see **Section 3.2**). Many farms that had relied on the usual supply of labourers and cottiers suffered. Food prices rose toward the end of December 1846, and so the same amount of work on the public relief schemes purchased less food (Daly 1995, 130). The numbers entering the Union Workhouses, the recently established government institutions to deal with destitute poor (see **Section 3.3.3**), began to increase as food became more scarce.

While the famine was a major catalyst in Irish history the impacts were not uniform across society (Ó Tuathaigh 1990). There were both regional and class variations. The famine was felt most acutely in the west and the southwest of the county, essentially the areas where the dependence on the potato was greatest, the population of poor was highest, sub-division of land was common, and trade and communications were poorly developed (Ó Tuathaigh 1990, 204-5). In general, the hardest hit counties were Sligo, Leitrim, Mayo, Galway, Cavan, Laois, Clare, Limerick, Cork, Kerry, and Tipperary. There were also variations within counties (Ó Tuathaigh 1990, 205). While it may be surmised that many of the victims of the famine were Roman Catholic, certainly poor Protestants also fell victim to the ravages of the famine and disease. Burial records indicate that in Bandon, Co. Cork, Protestant mortality was 60% higher between 1846-8 than in pre-famine years (Ó Gráda 2006b, 201).

The Great Famine changed the face of Ireland beyond all recognition. Its impacts were felt for decades, and longer, afterwards. It ensured the near obliteration of the very poorest. 'It was one of the ironies of the Great Famine that the virtual extirpation of the underclass which harboured the illness and infection rendered the future safer for the survivors and their children' (Geary 1995, 85). It acted as the final catalyst in terms of changes in land ownership and distribution. Previously cottiers and labourers were rented tiny plots of land in return for their labour, particularly in tillage agriculture. The fragile relationship was utterly shattered in the Great Famine (Smyth 2012b, 9). When the potatoes failed, the poor no longer had food, and they looked for payment in wages from the larger farmers and landowners. In turn, farmers now more frequently demanded rent in money rather than as labour. In addition, the so-called 'Gregory Clause' or 'Quarter Acre Clause' denied relief to those holding more than just quarter of an acre. As a result, there was a massive redistribution of land, as small farmers and cottiers were driven to leave their rotten potato patches in order to seek relief, and thus relinquish their leases back to the landowners. In addition, since 1843 landlords, not tenants, were liable for the payment of rates on properties valued at under £4 (Kinealy 1995, 116). This had devastating affects in the west of the country in particular, where small holdings were commonplace. It literally encouraged landlords to undertake large scale evictions. In Mayo, 75% of the holdings were valued at £4 or less (Donnelly 1995, 158). The levels of evictions increased exponentially after 1847. The evictions, combined with the need to be destitute even to receive temporary relief from the soup kitchens, as well as entry into the workhouses, essentially led to large scale land clearances and consolidation (Gray 1993b, 98; Kinealy 1995, 116). Not only was the structure of Irish society to change utterly with the famine, but so too the very landscape, where the multitudes of mud huts and tiny potato patches were obliterated from the land. Evictions, clearances, and consolidations were the order of the day during, and in the aftermath of the famine, and landowners and farmers were intent on keeping the land intact. It was the end of sub-division. The rise in larger landholdings and the massive decline in the tiny farms are evident in **Figure 3.2**.



	1841	1851
1-5 acres	44.9	15.5
5-15 acres	36.6	33.6
15-30 acres	11.5	24.8
30+ acres	7	26.1

Figure 3.2.
Land holdings changes pre- and post-famine (amended from Ó Tuathaigh 1990, 206)

3.4.1 Responses to the Famine

Responses to the Great Famine came from a variety of sources. The government, with its arsenal of the Poor Law system (which included the workhouses), and to a lesser extent, occasional outdoor relief, and public works schemes, played the greatest role. Soup-kitchens in particular played an important role. Emigration, both assisted and voluntary, acted as a vital pressure release valve on those left behind. However both private individuals and groups also contributed.

When the blight first appeared in 1845, Ireland was somewhat lucky in that Sir Robert Peel was Prime Minister. He had had extensive experience of dealing with famine in Ireland when he served as the Irish Chief Secretary between 1812 and 1818. The method of dealing with famine in Ireland was established from the onset of the famine in 1816. Apart from the newly established Poor Law Union workhouses, the system of relief included a dependence on local committees to administer the relief and the setting up of public works to allow those affected to earn money to buy food, rather than the provision of actual food. Local contributions towards relief schemes was a pre-requisite for government aid (Daly 1995, 124). When the blight reached Ireland in 1845, there was clearly some awareness of how a serious situation may develop. Numerous reports had been conducted on the condition of the poor in Ireland in the run-up to the Poor Law Union Act of 1838, and the reliance of the poor on the potato was well known. As early as 1845 Peel sent a chemist to Ireland to investigate the blight (Jordan 1998, 13). The actual relief response was also quick. Following previously established norms, the relief policy encompassed two main strands: a public works scheme and ensuring the supply of cheap food (Daly 1995; Ó Tuathaigh 1990, 208-9). The latter was initially a carefully concealed purchase of grain from America, which was realised into the Irish market in order to regulate prices (Gray 2012, 77). The swift response of aid, coupled with the fact that in 1845 the potato crop only partially failed, ensured that levels of distress and death were less than they could have been. In particular, Peel ensured the importation of cheap cereals through his persistence in the repeal of the Corn Laws. These laws, which applied to Britain as well as Ireland, imposed high duties on imported cereals in order to protect prices for locally-grown crops. The repeal of the laws ensured the flow of cheap cereals into Ireland to feed those suffering distress. However, so entrenched were the Corn Laws in the laissez-faire economic attitudes of the day, that Peel's interference with them was one of the main contributors to his ultimate downfall in

1846. Unfortunately, this was also the first year that the potato crop in Ireland was utterly destroyed by the blight.

As 1846 closed, conditions in Ireland became progressively worse. Seed potato, meant for the planting of the following year's crop, was consumed and disaster loomed. However, Peel's Tory government had been replaced by the Whig government of Lord John Russell, along with the assistant secretary to the Treasury, Sir Charles Trevelyan, both of whom were entirely different species of politician to Peel (Ó Tuathaigh 1990, 211). The primary policy of the new government was the protection of trade, and interference in the normal order of the day was not acceptable. It was the British government's obsession with maintaining free trade that dictated its response to the famine (Gray 1993b). The interference in the cereal market, such as was undertaken by Peel's government, would no longer be tolerated. The situation in Ireland was landed fully at the inability of the poor themselves to improve their own lot, or at least to retain dignity in poverty, and also at the Ascendency as a whole, who had proved themselves incapable of governing their own estates (Daly 1995, 126, 129; Gray 1995, 97; Ó Tuathaigh 1990, 213). The relief of the poor, and therefore the burden of payment, was increasingly placed on each individual Poor Law Union rather than on the Government itself (Kinealy 1995, 114). Therefore, the places that were worst hit by famine conditions had the highest expenses of trying to deal with the problems (Kinealy 1995, 107).

The attempted control of grain prices by the previous Tory government was reversed and privately imported cereal supplies dried up. Consequently the price of grain rose to double the normal price (Gray 2012, 78). Relief measures increasingly concentrated on public works, and not the direct provision of food, despite the deepening of the problem. As the crisis worsened from 1846 into 1847, thousands sought employment on the public works scheme. At its peak there were 714,390 individuals engaged in public works in March of 1847, with each labourer typically having four to five dependants (Gray 2012, 79). The public relief works schemes were a spectacular failure, unable to cope in any way with the huge numbers that sought work to buy food. Combined with winter conditions, the rising cost of food, the hard labour involved, and the general breakdown in societal norms, death and disease rates soared.

As the severity of the distress became apparent by the end of 1846, a somewhat extraordinary emergency measure was brought in, that of direct outdoor relief (Ó Tuathaigh 1990, 214). The British government, possibly spurred on by the success of the Quaker soup kitchens (see below) and seeing that the public work schemes and workhouses could no longer cope with the sheer numbers in destitution, passed the Temporary Relief Act in February 1847. The act was commonly referred to as the 'Soup Kitchen Act' (Crawford 1995, 67). By August of 1847 three million people were using these kitchens (Kinealy 1995, 113). This was in addition to people using the soup kitchens of the non-governmental agencies, for example, the Quakers (Ó Tuathaigh 1990, 215). The soup kitchens were only ever seen as a temporary solution. It was an 'unprecedented innovation', sanctioning state intervention to alleviate suffering in a time of extreme crisis, which essentially went against everything that the Whig government would have stood for (Gray 1993b, 97). This Act was followed in June 1847 with the Poor Law Amendment Act, which also saw a revision of the boundaries of the Poor Law Unions, with a subsequent increase from 130 to 163 Unions (Ó Tuathaigh 1990, 215-6).

Both the workhouses and the government soup-kitchens were very strictly regimented. Destitution was a prerequisite for aid. This is one of the gravest elements of the famine years: in effect, relief was withheld by the government until an individual was declared destitute. There are strong indications that this policy was linked with a general governmental drive to use the famine to instigate widespread land reforms, to ensure that the multitude of tiny landholdings would never happen again. 'After 1847, ideological and fiscal concerns, combined with a zealous determination to use the calamity to bring about long-term improvements in the economy of Ireland, took priority over the immediate needs of the distressed poor' (Kinealy 1995, 121). The aforementioned 'Gregory Clause', and the forcing of landlords to pay the rates of holdings of less than £4 in value (see **Section 3.4**), ensured that masses of cottiers and labourers were forced off the land.

Although many of the British public gave generously in response to appeals for help in the beginning, by 1847 many were becoming resentful of the support being given to Ireland (Gray 2012, 80). A certain element of 'compassion fatigue' had previously set in by the 1830s in response to earlier distresses (Daly 1995, 126). The character of the Irish was frequently called into question and, despite the Acts of Union, Ireland was seen by the British government as an errant child that had to be brought to heel for her own sake (Romani 1998). In Britain the potato was viewed as literally 'the root of all Irish evil'

(Whelan 1995b, 28). The blight did not occur in 1847 and all special relief efforts ceased. The British government declared that the famine was over. Yet 1847 is remembered in Ireland as being the worst year of the famine, 'Black '47'. Even the charitable organisations began winding down. The potato failures in 1848 and 1849 were considered to be on a typical scale of distress in Ireland, and government intervention was essentially one of inaction, with the onus being put squarely in the Poor Law Unions (Daly 1995, 133).

Despite its intense efforts, Britain still provided some relief to Ireland after 1847, but nothing like what was needed. The figures speak for themselves. In 1846 £4,848,000 was advanced for support of public works. After the government, and subsequently policy, change in Britain £156,000 was given for the Poor Rates in 1848, and in 1849 this had dropped to £114,000, over half of which was a loan (Kinealy 1995, 119). By 1848 most of the external charitable assistance had ceased (Kinealy 1995, 119). In a modern context, the British attempts to deal with the problems in pre-famine and famine Ireland were abysmal, and undoubtedly resulted in the unnecessary deaths of countless individuals (Ó Tuathaigh 1990, 115). Some have gone further and labelled the British response to, or indeed orchestration of, the Great Famine as genocide (Coogan 2012). Certainly, in the words of Dr O'Connor in Cork, paupers were 'the poorest inhabitants of the poorest districts… a degraded race, and encumbrance to society, a source of weakness to the Empire' (O'Mahony 2005a, 44). Their eradication from society could only prove beneficial. In the context of the period, more reforms were undertaken in Ireland than in most of Western Europe, and indeed in Britain, and particularly methods of relief cannot be looked at with modern morals (Daly 1995).

It was the newly constructed Poor Law Union workhouses which formed the primary basis of relief. Upon construction they had been put to the test in 1839 and again in 1842, when there was localised, but severe, distress. However, by 1846 the workhouses were only half full (O'Connor 1995, 120). With the advent of the Great Famine most of the workhouses quickly became overcrowded, despite the horrific conditions inside which included overcrowding, poor sanitation, and very inadequate food, as well as the risk of disease. Yet this was still preferable to the sheer destitution suffered by other individuals who lay dying in cabins surrounded by their own dead families. **Figure 3.3** provides some indication of the great rise in numbers of inmates, with the highest number of inmates recorded in 1851 (Lonergan 1992, 85). The inability of the system to deal with crisis periods was acknowledged even by its chief advocate Nicholls (Kinealy 1995, 107). Ironically, because each Union was responsible for their own Poor Law rates, those Unions that were worst hit, and so presumably those areas with the worst social conditions, were landed with the greatest costs of trying to deal with the crisis (Kinealy 1995, 107). Not every workhouse was equal. For example, 'a workhouse in which everybody died shortly after admittance might seem badly managed, but this is not a sound conclusion if this workhouse only attracted those in the most extreme state of need. Similarly, a workhouse where everyone lived might seem well-run, but it could also be one in which the master refused admittance to anyone who might actually need assistance' (Guinnane and Ó Gráda 2000, 2).

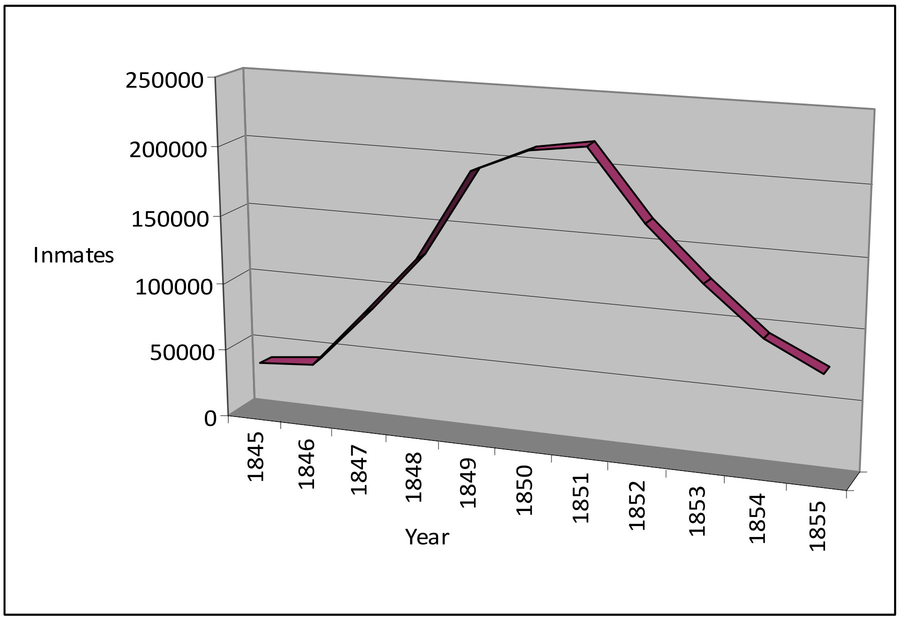


Figure 3.3.
Numbers of inmates in Irish Union Workhouses 1845-55 (amended from O'Connor 1995, 177)

Death became a common occurrence in the workhouses during the Great Famine. In the winter of 1846-47 workhouse mortality reached 2,500 deaths per week (Kinealy 1995, 118). The system as set up in 1838 simply could not deal with the situation brought about by the Great Famine. As the famine progressed discipline and order in the usually regimented workhouses gradually eroded. The food provided was also notoriously poor in quality. As potatoes virtually disappeared from the diet, the quality of the workhouse diet decreased further. As the numbers seeking admittance to the workhouses increased in the late 1840s and early 1850s, many of the institutions were unable to cope. There were riots in Dungarvan in 1846 when, unable to cope with the high numbers in the workhouse, breakfasts were not served until midday and dinner at midnight (Jordan 1998). Conditions varied dramatically between workhouses. In Ballinrobe the inmates got their rations raw in the morning and then cooked them wherever they desired, sometimes in rooms with no chimneys (Crawford 1995, 70). There are in fact numerous instances of inmates deliberately committing criminal acts in order to be transferred to the better conditions of the local gaol, where the diet was of a better quality (Clarkson and Crawford 2001, 184; Crawford 1995, 70; Pilcher 2006, 47).

The soup kitchens mentioned earlier have lived on strongly in Irish memory. In particular the accusations of 'souperism' or 's/he took the soup' are still used as insults today and relate directly to the events of the Great Famine and the soup-kitchens that were run by some charitable relief organisations run by religious groups. Essentially, food and shelter and care would be provided to those affected by the famine, primarily poor Roman Catholics, who were willing to convert. This was not a new phenomenon, and indeed the proponents of this method of conversion would have seen it as their holy duty to save the poor Irish Catholic from her/himself. The Hibernian Bible Society and the Religious Tract and Book Society distributed 4,400,000 manuscripts over the course of 10 years in the early nineteenth century (Ó Tuathaigh 1990, 59). Whelan (1995a) argues for anti-Catholicism in Britain in the nineteenth century being an actual political doctrine, with the government, and indeed the public, gripping steadfastly to the belief that Catholicism kept Ireland in the ignorance and stagnation that was proving such a drain on the Empire. She argues it was the evangelical attempts at reformation that ultimately led to the mobilisation of the Catholic clergy and the mass support for Daniel O'Connell and Catholic emancipation (Whelan 1995a, 137). With the granting of emancipation, and the funding of national schools by the government, the reformers turned their attentions towards the impoverished west. In 1830 the Protestant Colonisation Society was formed, with the Achill and Dingle missions of most note (Whelan 1995a, 138). In fact, it was in Dingle in County Kerry, during a famine and cholera outbreak in 1831, that the term 'souper' was first used (Whelan 1995a, 140). Some of the most intense proselytism was undertaken in the years 1848-50, perhaps not surprisingly coinciding with the period when the British government declared the famine over, and decreased the relief efforts. Food, clothes, land, labour, and money were all available for the price of conversion. Missions were particularly concentrated in the west also, which was also one of the areas most deeply affected by the famine (Moffitt 2008).

While there are arguments both for and against these proselytising missions, there can be little doubt that without them, and others such as the British Relief Association, Father Matthew in Cork, and various religious houses and some gentry (Crawford 1995, 66), the death toll would have been much higher. Local organisations, outside of the workhouse, were vital to the relief effort. As the famine and disease trudged on for years, many found it increasingly difficult to manage, in light of the enormous numbers seeking relief. However, even the poorest attempts were better than none at all. Skibbereen in County Cork is engrained in Irish memory as having suffered horrifically during the famine (Hickey 1995). It is of no small coincidence that it lacked any local relief organisations (Daly 1995, 131). Similarly, the presence or absence of clergy, particularly Catholic, had a huge influence on relief, with the former being preferable over the latter, as collections made by bishops could be distributed to priests of parishes (Daly 1995, 131-132; Kinealy 1997, 110). Connaught noticeably lacked Catholic clergy and suffered further as the organisers for relief, such as priests, simply were not there (Daly 1995, 131-132).

The proselytising and government soup kitchens should not be confused with those of the Society of Friends, more commonly know as the Quakers. Their kitchens asked for no conditions from the poor, and gave food to anyone in distress, no matter if they were destitute or not. The Quakers provided substantial relief to the poor during the Great Famine, and are still remembered for doing so in Ireland today. Unlike the proselytising missions referred to above, the Quakers were never accused of 'souperism'. In fact, they had a startlingly advanced view of distress and poverty, believing that the solution was not to either punish the pauper by incarceration in the workhouses, or force hard labour on them for minimal reward, but to engage with the poor on their own ground both in order to ascertain the reasons why the problems were there and how those problems could be solved (Hatton 2012). It was the Quakers' involvement in relief of the Greek famine of 1941-42 that ultimately led to the setting up of the relief agency Oxfam (Ó Gráda 2007, 18). In Ireland the Quakers opened their first soup kitchen in Charles Street, Upper Ormond Quay in Dublin on the 23rd January 1847, and soon spread out to many parts of the country (Crawford 1995, 66). The success of their kitchens made the government realise that this was a cheaper option of relieving the poor than the public works scheme, which ultimately resulted in the Soup Kitchen Act of 1847 (see above). However, following dwindling support, presumably linked with the aforementioned 'famine fatigue', the Quakers ran out of funding and were forced to cease relief in 1849 (Mahon 1991, 49).

The final method of dealing with the distress of the famine years was emigration. Emigration had been well established before the Great Famine, but it was the events of the mid-nineteenth century that ensured that emigration became an integral part of Irish life (Kennedy et al. 1999, 40; Ó Tuathaigh 1990, 141). As well as having implications for Ireland itself, the high levels of emigration had resonances further afield. It would be difficult to imagine the modern history of either Britain or the United States without the proportionally colossal impact of hoards of Irish workers. Until very recently the Irish heritage of candidates for the US presidency was a key factor in many campaigns. Indeed, in the American Community Survey of 2006 over 10% of American still claimed Irish ancestry (http://factfinder.census.gov 2006). Emigration increasingly played a key role in the system of famine relief, acting as a relief valve. Despite its ongoing legacy even today, in the mid-nineteenth century there can be little doubt that without emigration the death tolls would have been considerably higher and the existing relief efforts would have been under even more strain (if that were actually imaginable). There was both public and private assisted emigration schemes, as well as voluntary emigration by those able to afford it (Fitzgerald 1995). Emigration had been established before the famine, as a response to the social and cultural developments that emerged in the first few decades of the nineteenth century. However, 'reluctant parting from home was transformed by the [Great] famine into an exodus of mass panic from a stricken land' (Ó Tuathaigh 1990, 225).

As a result of slight variations in the Poor Law in Ireland and Britain, Irish paupers found wanting in Britain could literally be returned to the shores of Ireland. In contrast, there was no provision that English or Scottish paupers could be sent back to their respective countries (Lonergan 1992, 94). In reality, the numbers of either English or Scottish paupers in Ireland were probably negligible in comparison to the native paupers in Ireland, and it is likely that the differences in the laws was an attempt by Britain to curb the numbers of Irish poor that were already travelling there before the exodus of the Great Famine occurred. When Cork workhouse opened, the numbers of paupers transported back there from England increased. In September 1840, 150 paupers from London were landed in Cork, despite the fact that 120 of these were not originally from Cork (O'Mahony 2005a, 78). Through persistent criticism from the Poor Law Commissioners in Ireland the law was finally changed so that the period of residence (in Britain) was reduced from five years, to three years, and finally to one year in 1866 (Lonergan 1992). Assisted emigration, which could be termed forced emigration, also became a feature, both of tenants from estates, and from the workhouses. The variations, as in all aspects of the Great Famine, were significant.

Hundreds of inmates were sent from the workhouses of Kerry and Clare in 1851, yet only six people were sent from the Dublin North and Dublin South Unions (Lonergan 1992, 64). Women and girls in particular were favoured for emigration. Between 1848 and 1850 alone, 4,000 females between the ages of 14 years and 20 years were sent to Australia (McClaughlin 2000, 30). Even after the famine, between 1851 and 1870, 27,425 people from workhouses were assisted to emigrate (Lonergan 1992, 111). While most probably struggled through, some may have excelled in their new lives. But there must have been many heart-breaking stories, such as that of Alice Ball. She was an orphan in Enniskillen Workhouse. In 1849 she, along with her sister and other orphans, was transported to Port Phillip Bay in Australia. In April 1850 sixteen year old Alice drowned herself in the River Yarra, after becoming pregnant by her employer (McClaughlin 2000, 31-2).

3.4.2 Diseases, Dietary Deficiencies, and Death

The most common cause of death during a famine is rarely just starvation. Disease, and specifically infectious disease, typically plays a very important role in mortality rates and its spread is often as a result of the social upheaval that may have caused the famine to begin with, or which often occurs as a result of famine. However, there have been a number of famines in the twentieth century where starvation was the main cause of death (Ó Gráda and Mokyr 2006a, 81). An estimated 500,000 Polish Jews were starved in the Warsaw ghetto at the beginning of 1942, while starvation was also the primary cause of death during the World War II famines in Leningrad in Russia, western Holland, and Greece (Geary 1997, 99; Ó Gráda 2007). The starvation in the Warsaw ghetto was deliberately devised by the occupying Germans. The rations allocated in occupied Poland in 1941 were as follows: 2,613 calories a day for Germans, 699 calories for Poles, and 184 calories for Jews (Russell 2005, 96). However, in most historic famines, and many African famines, the main causes of death relate to disease. This is as a result of prevailing social conditions, as well as either a lack of medical understanding about epidemiology in the case of many historic famines, or lack of access to medicines in the case of many African famines (Ó Gráda and Mokyr 2006a). Crucially, it has been found that the types of deaths that occur in famine are significantly influenced both by the intrinsic mortality patterns and whether social structure is maintained during the crisis (Hionidou 2002). The causes of death during the Great Famine mirror the predictions in **Figure 3.4**, when there is a breakdown of social order, and/or that the resources to hand are simply incapable of dealing with the events. The nature of the famine in Ireland ensured that the numbers of destitute increased dramatically as the distress dragged on for seven years. Destitution was a key factor to the high levels of mortality during the Great Famine (Ó Gráda 1995). It ensured the complete breakdown of normal life, and made individuals more susceptible to diseases.

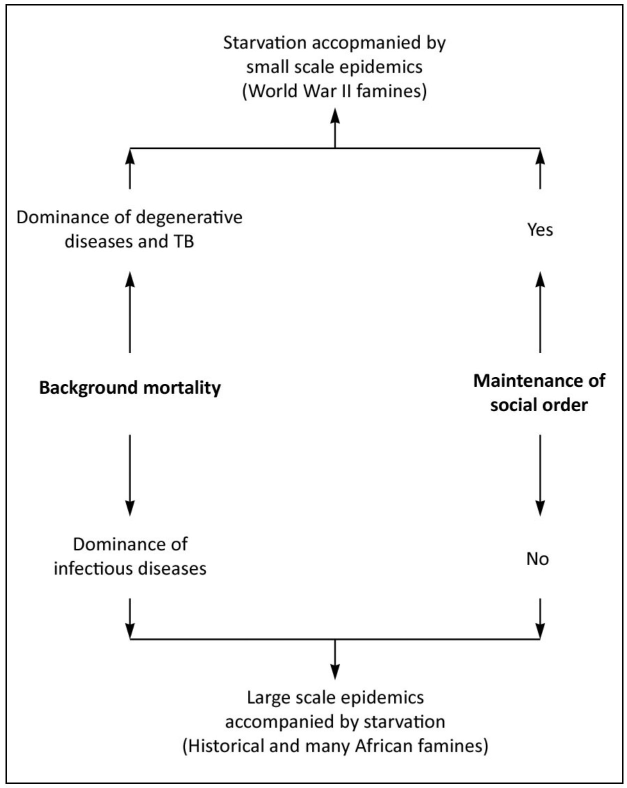


Figure 3.4.
Elements in determining the course of a famine,
based on famines on three Greek islands during WWII (from Hionidou 2002, 75, fig. 3)

Malnutrition has three manifestations: consuming too little food, consuming too much food, and consuming an imbalanced diet (Frazier et al. 1996, 206). The first and the last were the problematic issues in the Great Famine. Starvation today is defined as death as a result of 'attrition of protein and fatty deposits in the body causing gradual systemic atrophy, especially of the heart muscle' (Mokyr and Ó Gráda 2002, 340). In reality, it is probable that pure starvation was not common during the Great Famine. Three terms in the literature of the day are likely to refer closely to the modern interpretation of starvation. These include 'starvation', 'dropsy', and 'marmamus' (Mokyr and Ó Gráda 2002; Ó Gráda and Mokyr 2006a). 'Dropsy', now referred to as oedema, is a swelling due to fluid accumulation, which may often accompany acute starvation. 'Marasmus' is a form of severe protein-energy malnutrition in infants and young children (Mokyr and Ó Gráda 2002, 340; Ó Gráda and Mokyr 2006a, 64). However, the latter two conditions were recorded in the Irish census records well before the Great Famine, even in times of no recorded food shortages, while in 1847 or 'Black '47', the worst year of the famine, just over 6,000 people were reported to have died of actual starvation out of a total of 250,000 deaths (Ó Gráda and Mokyr 2006a, 64). This highlights the difficulties in assessing the medical records of the time.

The diseases that occured break down into a number of distinct categories, and relate both to changes in food consumption, increased exposure to infectious diseases, and unrelated diseases that may be exacerbated by the conditions that prevail during social stress (Mokyr and Ó Gráda 1999, 4-5; Ó Gráda and Mokyr 2006a). Digestive diseases and disorders, related to a decline in food quality and the consumption of things that would never normally be eaten, such as diseased or rotten food, were common. Unfamiliar emergency foods also proved problematic, particularly the infamous Indian maize or corn meal. The meal, provided by the government, had to be soaked in alkaline water, such as limewater, in order to release the B-Vitamin niacin. If someone is relying almost solely on meal for their diet and did not soak it accordingly, then there is a very real risk of niacin deficiency, namely pellagra. The disease was common during the Great Famine (Ó Gráda 2006a, 203). It is frequently characterised by the three D's – dermatitis, diarrhoea, and dementia. The link between pellagra and incorrect maize meal preparation was not established until the twentieth century (Hegyi et al. 2004). Crucially, literacy levels were a significant factor as written instructions on how to prepare the meal was only beneficial to those who could actually read (Smyth 2012c). Regional variation was a key factor in terms of literacy. In 1841 17.5% of males over the age of 5 years in St Anne's Parish in Dublin could neither read nor write. In Dún Chaoin in Kerry this figure was 94.8% (Mokyr and Ó Gráda 1988, 226). As was to prove increasingly the case, education was the most powerful class and status changer of all (Cronin 2010). In addition to the need to soak the meal, if it was not properly ground its sharp edges were actually capable of piercing the intestinal wall, which could result in a whole host of other problems. Most of the traditional grinding mills, that had actually survived the onslaught of the potato replacing grains, were unable to cope with the much tougher whole maize grain, which had to be chopped in steel mills (Crawford 1995, 63-64).

The failure of the potato led to a reduction both in the quality and quantity of foodstuffs (Ó Gráda and Mokyr 2006a, 64). Even before the famine there were indications that some people only half-cooked the potato, leaving the central portion raw, in the belief that it would stay in the stomach longer and stave off hunger pangs (Clarkson and Crawford 2001).

In reality the body was deprived of the valuable nutrients in the cooked potato as raw potato cannot be digested (ibid.). One of the major factors that emerged during the famine was the onset of vitamin C deficiency or scurvy (see **Section 7.3.2**), which has been attributed directly to the sudden absence of the potato in the diet. The potato diet combined with buttermilk, the mainstay of the poor in the nineteenth century, was highly nutritious, providing all the necessary vitamins and nutrients. Scurvy was virtually unheard of prior to the Great Famine (Crawford 1995; Geber and Murphy 2012). During the Great Famine scurvy appeared extraordinarily fast in the Irish poor (Clarkson and Crawford 2001, 147; Ó Gráda 2006a, 203). Two reasons are apparent. Firstly, vitamin C cannot be stored by the body so a person cannot build up reserves. Secondly, the complete domination of the diet by the potato, ensured individuals were used to high doses of vitamin C. The sudden drop in intake brought the onset of scurvy quickly (Crawford 1995, 71). The frequency of the disease in workhouses forced the Poor Law Commission to act. Scurvy was linked with insufficient milk and vegetables in the diet, and consequently the Commission recommended the inclusion of well-cooked vegetables in the workhouse menu. Unfortunately, the recommendation of 'well-cooked' ensured the destruction of the vitamin C (Crawford 1995, 71).

Another very common affliction reported during the famine, though not actually fatal, was an eye disease that caused blindness. It was called ophthalmia by contemporaries (Clarkson and Crawford 2001, 150; Crawford 1995, 72; Ó Gráda 2006a, 203; Kennedy et al. 1999, 111). Occurrences were reported throughout the eighteenth and nineteenth centuries. However, ophthamia is a contagious infectious disease, and present indications suggest that at least the outbreak that was reported in the late 1840s was in fact xerophthalmia, an eye disease that occurs as a result of a deficiency in Vitamin A. The disease became rampant in the workhouses (Clarkson and Crawford 2001, 150). Potatoes, the subsistence food of the poor, lack vitamin A. However, the consumption of wholemilk and herrings would have provided the necessary levels to stop the disease. Unfortunately, there was a significant increase in the consumption of buttermilk and skimmed milk well before the Great Famine, which ensured the disease became well known. The workhouse diet completely lacked any vitamin A, so individuals already lacking in the vitamin were significantly affected on entering the workhouses. Xerophthalmia damages the iris, conjunctivae, and cornea of the eye, and ultimately leads to blindness, typically in one eye (ibid.). In 1851 45,947 inmates in workhouses were suffering from opthalmia. Of these, 263 lost the sight in both eyes, 656 lost the sight in one eye, and there was a reduction in sight in another 754 individuals (Lonergan 1992, 63). Interestingly, Dr William Wilde recommended the use of cod liver oil to combat the disease, a full sixty years before that fact was officially recognised (Kennedy et al. 1999, 112). While the condition did not kill, it would only have added to the misery of those already suffering from food deprivation and disease. In addition, if an individual did survive, their remaining life could have been significantly affected by the blindness.

This is an important factor to consider, although the full consequences may never be realised. There were factors that affected those who survived the Great Famine, and those individuals cannot even be counted among the typical estimates of those who died or emigrated. The long term consequences of malnutrition could and can be significant, with possible serious implications for the rest of the life of a survivor. The blindness associated with vitamin A deficiency has been mentioned. Lack of vitamin B may have neuropsychological complications (Kelly 2004). Teeth may be lost to vitamin C deficiency with implications for food consumption in later life. Lack of vitamin D in children can affect their bones through rickets. Time does not necessarily provide us with solutions to these problems. Vitamin A deficiency and vitamin C deficiency have been reported in individuals on food-aid programmes, despite the wealth of knowledge available (Ahmad 2002).

Diseases associated with inadequate food consumption or food preparation, as well as malnutrition and undernutrition, undoubtedly killed and maimed. However, it was the infectious diseases that took the real death toll. These included typhus, typhoid, relapsing fever, dysentery, diarrhoea, tuberculosis, bronchitis, influenza, smallpox, measles, and cholera (Geary 1996a, 27; Geary 1996b; Geary 2012, 199). The latter in particular had no connection with the famine, it was a coincidental outbreak (ibid.; Geary 1995, 81). Yet given the prevailing conditions of many of the poor at the time, it had significant impacts on mortality. The main increase in population, noted earlier, was in the rural areas in the west of Ireland (Whelan 1995b). The traditional type of settlement in that area was the clachan, a 'village' of farmhouses generally quite densely packed. The high population and the density of that population facilitated the spread of disease even before the countless numbers of destitute mendicants began to wander the roads. When that began, the development and spread of all of the contagious diseases was easily facilitated by the breakdown in social order, with the mass movement of destitute people seeking relief, and the decline in hygiene, as well as the susceptibility of bodies weakened by poor food or no food. The 'epidemic triumvirate' of fever (relapsing and typhus fever), dysentery, and smallpox are likely to have been the primary killers during the famine (1995, 77; Geary 1996a). Fever, dysentery, smallpox, and cholera, are examined in more detail elsewhere (see **Section 7.3.1**).

Fever warrants a particular mention here as it featured large in the landscape of the famine. Fever was already endemic in eighteenth and nineteenth century Ireland, but with the breakdown in societal norms associated with the Great Famine it became rampant. The clear evidence of its potency is shown in the sheer numbers of additional fever sheds and hospitals that were ordered for construction in the late 1840s (see O'Connor 1995). Almost one-third of deaths (29.2%) of death of the period have been attributed to it (Ó Gráda 2012b, 173). In the 1840s fever was referred to as 'famine fever', 'starvation fever', 'the fever', 'relapse fever of 1847', 'five days' fever', and 'road fever' (Geary 1995, 83). Many of the names are a reflection of the manner in which the diseases typically spread by the wandering destitute and often transmitted to those attempting to help.

'The fever' was actually two different infections: typhus fever and relapsing fever, with both being very similar and transmitted by lice (Geary 1995, 75; Geary 2012, 199) (see **Section 7.3.1**). The two fevers tended to occur more frequently in certain classes and they had different mortality rates. Relapsing fever was common among the poor, while typhus tended to affect those in the higher classes, invariably with higher mortality rates in the latter also (Geary 1995, 83; Geary 2012, 199). While the mortality rates of fever were typically lower in the poor, there were side-effects that could be devastating. Due to its recurring nature, a family, particularly if the primary bread-winner was struck down, could be afflicted with the disease for months. That was the catalyst that could push a family that was surviving right over the edge into utter destitution (Geary 1995). The pattern, once established, was cyclical and devastating. Those who are suffering under/malnourishment are more susceptible to disease, which in turn makes them even weaker. In desperation people move in search of relief, which both destroys the existing social order and causes severe problems further afield as the unfortunates crowded into cities. Unlike the poor, it is unlikely that the middle and upper classes had built up any immunity to fevers in particular, and many fell victim to the various fevers, as stated particularly to typhus fever. Mortality rates were especially high in those individuals attempting to relieve suffering, namely medical staff and the clergy (Ó Gráda 2006a, 203). In the Catholic diocese of Cloyne and Ross in Cork, 17 priests died by the end of 1847 as a result of their involvement with the poor (Ó Gráda 2012b, 172). Dysentery, diarrhoea, and gastroenteritis were also very common during the Great Famine, and almost a quarter of deaths (24.9%) have been attributed to these disorders (Ó Gráda 2012b, 173). These are common in most famine crises, even today, particularly when access to basic medication is limited or absent (Ó Gráda 2009, 115). Breakdown in social norms ensured they were rampant during the Great Famine. Smallpox and cholera were also prevalent, yet were completely unrelated to the latter. They would have claimed thousands of lives, with or without the advent of food shortages, although the breakdown in social order ensured that cholera in particular thrived in the unsanitary conditions.

The devastating Great Famine of 1845-1852 was a culmination of at least two centuries of gradually escalating stresses. Famine and disease, maiming and death, had become the order of the day for the increasing population of poor. The middle and upper classes were largely shielded, at least from the food shortages and the social disorder which became an increasing part of life for most of the population of Ireland. Disease was less discriminate however. This study examines the skeletal health profiles of some of these socio-economic groups. The next chapter (**Chapter 4**) will present the backgrounds to the sites chosen for this study, as well as the basic osteological information from the skeletal assemblages.

CHAPTER 4:
Methods and Materials

4.1 Introduction

The osteoarchaeological populations utilised in this study (all analysed by the writer) comprised three social groupings, with each consisting of varying numbers of skeletal samples from recently excavated post-medieval cemeteries. The three social groups have already been examined in **Section 2.6**. Two cemeteries that related directly to nineteenth century Poor Law Union workhouses were Manorhamilton in Co. Leitrim and Cashel in Co. Tipperary. These cemeteries primarily contained individuals from the lowest level of the social scale, as typically one had to be destitute in order to gain admittance. The institutions specifically date from the 1840s onwards. A number of small cemetery samples, that primarily comprise individuals that originated from the middle social classes, were amalgamated for the present study to form the second social group. These included samples of the Church of Ireland populations from the Cathedral of St Mary the Virgin and St John the Baptist in Sligo, St Mary's Church in Clonsilla in Dublin, St Fachtna's Cathedral in Rosscarbery in Co. Cork, and Church Street in Finglas in Dublin (associated with St Canice's Church), as well as a Quaker cemetery sample from St John's Lane in Waterford City. These cemeteries have broader spans of use than the workhouse cemeteries, dating from the seventeenth century through to the twentieth century. Finally, the third group was represented by a large cemetery population from St Anne's Church in Shandon in Cork. This skeletal sample was representative of a mixed population.

The methodologies, applied in both the general osteoarchaeological analysis of these cemetery sites and in the specific factors examined in this study, are presented in **Section 4.2**. The history of each individual site is then presented (**Sections 4.3**, **4.4**, and **4.5**), along with the general osteoarchaeological results. Each cemetery examined in the present study is listed in **Table 4.1**, along with location information and details on whether the site is on the statutory Record of Monuments and Places (RMP).

Table 4.1.
Cemetery sites used in present study,
with location coordinates and relevant RMP (Record of Monuments and Places) numbers

	Site	County	ITM[1] (E, N)	RMP No.	RMP descript.
Workhouses	Manorhamilton	Leitrim	589110, 839478	n/a	
	Cashel	Tipperary	607336, 640046	n/a	
Middle-class	Cathedral of St Mary the Virgin & St John the Baptist, Sligo town	Sligo	568896, 835811	SL014-065010- SL014-065003-	Church Hospital
	St Mary's Church, Clonsilla	Dublin	704897, 738290	DU013-017001- DU013-017002- DU013-017003-	Church Graveyard Graveslab
	St Fachtna's Cathedral, Roscarbery	Cork	528640, 536674	CO143-023008- CO143-023007- CO143-095--- CO143-096---	Cathedral Graveyard Font Font
	Church St. (associated with St Canice's Church), Finglas	Dublin	713083, 738811	DU014-066009- DU014-066-010- DU014-066-015- DU014-066-016-	Church High Cross Graveslab Graveslab
	John's Lane, Waterford City	Waterford	660578, 612140	WA009-005123-	Burial ground
Urban	St Anne's Graveyard, Shandon	Cork	567293, 572407	CO074-033002-	Graveyard

[1] ITM refers to Irish Transverse Mercator, the geographic coordinate system for Ireland, E – easting, N - northing

4.2 Osteoarchaeological Methodologies

In this section, the general osteoarchaeological methodology that was employed in the analysis of all of the selected sites (**Sections 4.3**, **4.4**, and **4.5**) will firstly be described (**Section 4.2.1**). Then, the methodologies that were utilised for the three selected indicators of health (see **Section 2.6.1**), will be described. These include the methodologies used in the assessment of stature and femur length (**Section 4.2.2**), in the recording of dental carious lesions and ante-mortem tooth loss (**Section 4.2.3**), and in the examination of non-specific infections (**Section 4.2.4**). The latter three methodologies should be considered in the context of the relevant chapters: **Chapter 5**, **Chapter 6**, and **Chapter 7** respectively.

4.2.1 General Osteoarchaeological Methodology

All of the cemetery samples utilised in the present study were originally analysed as individual osteoarchaeological sites. The same osteoarchaeological methods of analysis were used for each site. The exception was the skeletons from the Cathedral of St Mary the Virgin and St John the Baptist in Sligo. When these skeletons were originally excavated in 2000, the osteoarchaeological analysis was restricted by circumstances beyond the control of the writer, and the skeletons could not be fully analysed (see **Section 4.4.1**). All other skeletons were fully processed in post-excavation by washing, following the standard recommendations of Buckley et al (1999). A catalogue was complied for each individual, with the analysis being undertaken following the methodology outlined below.

The ages-at-death of the adult individuals were determined on the basis of the morphology of both the auricular surface of the ilium (Lovejoy et al. 1985), and the pubic symphysis (Brook and Suchey 1990). The method of assessing the rates of dental attrition to determine age-at-death of the adults (Brothwell 1981, 71-72) was not utilised. Dental attrition may be affected by a wide variety of factors, such as individual mastication or chewing traits, dietary preferences, and access to foodstuffs. Rates of fusion of secondary epiphyses were considered in relation to any younger adults (Scheuer and Black 2000). The adults were assigned into broad age categories, which included 'young adult' (18-24 years), 'middle adult' (25-44 years), and 'old adult' (45+ years). The middle category was further divided into 'young middle adult' (25-34 years) and 'old middle adult' (35-44 years). The sex of the adults was determined on the basis of morphological traits in the pelvis and skull (Buikstra and Ubelaker 1994) and on metrical analysis (Bass 1995). In general, females tend to be slender and small, with marked particular traits in the pelvis for the birthing process. Males tend to be larger and more robust. The statures of the adults were initially estimated using the equations of Trotter (1970), although these were recalculated for the present study (see **Section 4.2.2**).

The methods used in the determination of the age-at-death of juvenile individuals are more accurate and specific, and are assessed on the basis of the known rates of growth and development of parts of the skeleton. The primary methods that were utilised were the rates of calcification and eruption of the deciduous and permanent teeth (Moorrees et al. 1963a; Moorrees et al. 1963b; Smith 1991). The lengths of the long bones were also used to determine the age-at-death (Maresh 1970; Scheuer and Black 2000). However, long bone growth is highly influenced by nutritional factors and priority was given to age-at-death from dental remains. The juveniles were grouped into broader age ranges of 'infant' (<1 year), 'juvenile1' (1-6 years), 'juvenile2' (7-12 years), and 'adolescent' (13-17 years).

Permanent teeth were recorded using the following chart:

18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38

right *left*

The upper row represents the maxilla and the lower row represents the mandible. These are further sub-divided into left and right quadrants. Each permanent tooth (1-8) is prefixed by the number of the quadrant it belongs to (1-4).

Deciduous teeth were recorded using the chart below:

55	54	53	52	51	61	62	63	64	65
85	84	83	82	81	71	72	73	74	75

right *left*

Again, the upper row represents the maxilla while the lower row represents the mandible, and is subdivided into left and right quadrants. Each deciduous tooth (1-5) is prefixed by the number of the quadrant it belongs to (5-8). In some instances, a combination of the two charts was used.

The following symbols may be used to record the teeth:

P - *tooth present*	B - *tooth broken post-mortem*
E - *tooth erupting*	PM - *tooth lost post-mortem*
U - *tooth unerupted*	AM - *tooth lost ante-mortem*
CA - *tooth congentially absent*	R - *root only*
~~12~~ - *socket absent*	

All incidences of dental diseases such as calculus, caries, abscesses, enamel hypoplastic defects, as well as any other anomalies, were also recorded.

Skeletal pathological conditions were extensively recorded and included instances of degenerative joint disease, metabolic conditions, non-specific and specific infections, trauma, neoplastic disease, and congenital malformations.

4.2.2 Stature and Femoral Length Methodology

Stature was estimated for any and all individuals in this study where possible. Any stature estimates derived from bone are inherently imbued with errors, as they are only approximate indicators. 'Stature predictions are only estimates of stature and as such have errors associated with them. Any data analysis should therefore concentrate upon using the raw long bone lengths rather than predicted statures…' (Brothwell and Zakrzewski 2004, 33). However, archaeological reports routinely use stature estimates as a basic means of comparing sites across space and time. The errors for male adults range from +/-2.99cm for using the femur and tibia to estimate stature to +/-4.32cm for the radius. In female adults the errors range from +/-3.53cm for the femur and tibia to +/-4.42cm for the ulna (ibid.) (see chart below). The errors are therefore an integral part of examining statures in archaeological populations. Femoral length, being from the more reliable (in terms of stature estimation) lower limbs and being easy to measure, may be exclusively used to estimate the stature of individuals. However, stature estimates have been utilised in a number of very broad ranging osteoarchaeological studies, and few have confined themselves exclusively to using the femur only for stature estimation (Roberts and Cox 2003; Steckel et al. 2002; www.global.sbs.ohio-state.edu/global.php).

Following those examples, stature was estimated for as many individuals with intact long bones as was possible. That is, if the length of any long bone could be measured, then stature was calculated. This was especially to maximise the sample size and to provide statistically viable numbers of individuals. This was particularly pertinent regarding the middleclass group, as these comprised a number of sites containing small numbers of skeletons that had to be pooled in order to increase the final sample numbers for analysis. Priority has been given to the lower limbs, as these generally have smaller associated errors (Bass 1995; Brothwell and Zakrzewski 2004). The standard equations that were used followed the standards recommended by the British Association for Biological Anthropology and Osteoarchaeology or BABAO (ibid.). This recommended the equations that were formulated on data collated from US casualties from the Korean War and on the large skeletal Terry collection held in the Smithsonian Museum in Washington (Trotter 1970; Trotter and Gleser 1952; 1958; 1977). Some researchers have recommended that the tibia should be excluded in stature studies as there is some evidence to suggest that the measurements used by Trotter excluded the medial malleolus (Jantz et al. 1995; White and Folkens 2005, 399-400; White et al. 2011, 421). However, it is included here on the basis of the recommendations of BABAO (Brothwell and Zakrzewski 2004).

There are recognised errors in calculating stature using skeletal remains. It can allow a certain level of comparison between contemporary archaeological sites other than those examined in this study, but statistically, the statures are estimates and are not definitive. The inclusion of long bone length data is highly recommended in growth studies (Brothwell and Zakrzewski 2004). In order to gain additional insight into the statures of these populations the length of the femur was also assessed. This bone is classically regarded as one of the prime indicators of skeletal growth. Leg length is a crucial factor in terms of height increase, as opposed to trunk length (Tanner et al. 1982). Thus while the stature estimates allowed for correlations to be made generally across numerous other contemporary sources, the femur length allowed for a more direct assessment of growth within these Irish groups. The left femur was given priority, with the right being substituted when the former was either absent or incomplete.

The calculated estimates and measurements taken in order to examine the questions raised in **Section 5.6** included:

- Overall average statures for females and males;
- Female and male average stature for each of the three groups;
- Femoral length by sex and age-at-death for each group.

The long bones were measured on a standard osteometric board, following the established standards (Buikstra and Ubelaker 1994). The statures were calculated using the following formulae, and they are listed in order of preference (ibid., 33):

Female *(American Whites)*	**Males** *(American Whites)*
0.68XLH+1.17XLF+1.15LCT+50.12+/-3.51	1.30(XLF+LCT)+63.29+/-2.99
1.48XLF+1.28LCT+53.07+/-3.55	2.38XLF+61.41+/-3.27
1.39(XLF+LCT)+53.20+/-3.55	2.68XLG+71.78+/-3.29
2.93XLG+59.61+/-3.57	2.52LCT+78.62+/-3.37
2.90LCT+61.53+/-3.66	1.31(XLF+XLG)+63.05+/-3.62
1.35XLH+1.95LCT+52.77+/-3.67	3.08XLH+70.45+/-4.05
2.47XLF+54.10+/-3.72	1.82(XLH+XLR)+67.97+/-4.31
4.74XLR+54.93+/-4.24	3.70XLU+74.05+/-4.32
4.27XLU+57.76+/-4.30	3.78XLR+79.01+/-4.32
3.36XLH+57.97+/-4.45	

Abbreviations: ZLH – humerus length, XLR – radius length, XLU – ulna length, XLF – femur length, LCT – tibia length, XLG –fibula length. All lengths in cm.

All measurements and calculations were rounded off to one decimal place. The statistical package utilised to assess the data was Stata 10, which also provided an overall standard deviation for the stature estimates. Overall comparisons were undertaken using one-way analysis of variance (ANOVA), with p-values of less than 0.05 considered significant. Comparisons between groups were undertaken using the Bonferroni test, again with p-values of less than 0.05 considered significant.

The raw data used for the stature and femoral length analysis is provided in **Appendix Section 9.1**.

4.2.3 Carious Lesions and Ante-mortem Tooth Loss Methodology

The study of carious lesions generally falls into two schools: osteoarchaeological studies and clinical studies. Invariably the clinical studies aim at a greater understanding of the aetiology, development, and progress of the disease in order to come to a greater understanding of the disease. One of the primary reasons for the extensive tracking and research of the disease in recent times has been the costs of treating the disease. It accounts for between 4-11% of the health budgets of European countries (Sheiham 2001), and affects between 60-90% of children and the majority of adults (Petersen and Lennon 2004).

Clinical caries studies typically use at least one of two indices: the DMFT or Diseased, Missing, and Filled Teeth, and the DMFS or Disease, Missing, and Filled Surfaces (Wasterlain et al. 2009; Hillson 1986). These are inappropriate in terms of archaeological skeletons, where missing teeth lost ante-mortem can occur due to a variety of factors (Hillson 1986), and filled teeth, at least in an Irish archaeological context, are negligible. Assuming that all missing teeth in a sample represent losses by caries could introduce considerable biases into the data. In addition, there may be significant biases in the fact that caries most frequently involves the molars (ibid.). Anterior teeth are frequently lost post-mortem in archaeological samples. It may therefore be surmised that caries frequencies in archaeological contexts may be overestimated. However, the clinical definition of caries also includes the demineralisation stage, when the enamel is discoloured as a result of the process, and radiographs may be used to confirm of the present or absence of caries. This is rarely recorded in archaeological populations due to taphonomic processes which can stain the enamel. Lesions that had reached the severity of a cavity at the time of death are the only manifestations that are recorded in skeletal assemblages. Thus, in contradiction to post-mortem loss of teeth mentioned above, it may also be surmised that the prevalence in an archaeological sample may in fact be an underrepresentation of the actual prevalence.

The most typical method of assessing caries in archaeological populations is to assess the total number of individuals with caries in comparison to the total number of observable individuals (that is, individuals with teeth), and also to assess the total number of teeth affected in comparison to the total number of teeth observable. The former may act as an indicator as to how many people suffered the disease, while the latter may indicate the level of severity. Numerous efforts have been made to correct for the incomplete nature of archaeological dentitions: the so-called 'correction factor' (Erdal and Duyar 1999; Lukacs 1995). The correction method essentially assumes that all teeth lost ante-mortem were lost as a result of caries, and these are then added into the counts of the extant carious teeth. However, the argument against using this practice with archaeological material is clear, given that teeth may be lost ante-mortem in archaeological populations due to a variety of factors (Hillson 1986; Wasterlain et al. 2009). Even when this correction method is used, the results have shown that there may be minimal changes to the prevalence rate of caries as normally calculated for archaeological populations. In their study of caries in an early seventeenth century Swedish population, Lingström and Borrman (1999) found that only minor changes occurred to their original data when they took into consideration the teeth lost ante-mortem. The caries correction factor was specifically applied in a study of the dental health of nineteenth century migrant mine-workers in South Africa (Van der Merwe et al. 2010c). Even so, the rate of caries in that population was low, despite the expectations of a high prevalence. However, it is important to note that where there are high prevalence rates of both caries and ante-mortem tooth loss, it is likely there is at significant link between the two. Therefore the calculation of ante-mortem tooth loss prevalence is a very important factor in osteoarchaeological studies. In this study, the correction factor was not applied in the assessment of caries. Instead, AMTL was examined in specific detail.

The primary aim of examining the caries in the post-medieval groups in this study was to determine differences, if any, in the prevalence of the disease between the three main groups, as well as to make comparisons with past and contemporary populations. It was not intended as a detailed study of caries in isolation. The standard methods that are used in osteoarchaeological studies in Ireland are based on the standards as followed by the Irish Association of Professional Osteoarchaeologists, which in turn are based on *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994). Macroscopic methods have been found to be reliable in the assessment of the presence of caries in archaeological populations (Kerr et al. 1988), and these have been exclusively used in the present study.

The methods used in the recording of the dental remains have already been detailed in **Section 4.2.1**. With regards specifically to caries, the severity of the lesion was recorded in terms of 'small' (pin-point to a quarter of the crown), 'medium' (quarter of the crown to half the crown), and 'large' (anything more than half the crown), and the location of the lesion on the tooth was also recorded using the following: 'buccal', 'lingual', 'mesial', 'distal', 'occlusal', 'root', and 'origin obscured'.

The general prevalence rates that were examined in order to address the questions raised in **Section 6.5** were:

- Prevalence rate of caries by observable individuals overall, by group, and by sex;
- Prevalence rate of caries by observable socket overall, by group, and by sex;
- AMTL by observable individual overall, by group, and by sex;

- AMTL by observable socket overall, by group, and by sex.

The two caries prevalence rates for each group and sex were calculated as follows:

$$\frac{\text{Total number of individuals with caries}}{\text{Total number of observable individuals with teeth}} \text{ X } 100$$

$$\frac{\text{Total number of carious teeth}}{\text{Total number of observable teeth}} \text{ X } 100$$

Ante-mortem tooth loss, or AMTL, was assessed on the basis of the remodelling of the tooth socket. It was only recorded as such when it was clear that it was very unlikely that a socket could have retained a tooth. Therefore, the AMTL prevalence rates are a minimum estimate.

The two AMTL prevalence rates for each group and sex were calculated as follows:

$$\frac{\text{Total number of individuals with AMTL}}{\text{Total number of observable individuals with sockets}} \text{ X } 100$$

$$\frac{\text{Total number of teeth loss AM}}{\text{Total number of observable sockets}} \text{ X } 100$$

Prevalence rates were reported both as the number of individuals affected by carious lesions and AMTL, and by the number of teeth affected by caries and AMTL. While both are generally reported on in osteoarchaeological assessments, priority is generally given to the prevalence rates by observable tooth or socket. These rates are generally considered more reliable indicators. In the individual rate, a person with one carious lesion will be assigned the same rating as an individual with ten carious teeth. In contrast, data representing the number of teeth/sockets affected by the total number observable acts as a more sensitive register of the occurrence of caries and ante-mortem tooth loss (Roberts and Cox 2003, 396).

The statistical package utilised to assess the data was Stata 10. Pearson's chi-square test was used to compare the prevalence rates. P-values of less than 0.05 were deemed significant, and all significant results are highlighted in bold where relevant. All data has been rounded off to one decimal place, apart from the data provided directly from Stata

10. In tables and figures, '*n*' refers to the numbers of individuals or teeth affected, while '*N*' refers to the total number of observable individuals or teeth.

The raw data on carious lesions and ante-mortem tooth loss is provided in **Appendix Section 9.2**.

4.2.4 Non-specific Infection Methodology

Reference has already been made to the fact that periosteal lesions may be caused by processes other than just infection (see **Section 7.4**). In addition, in archaeological samples it may be difficult to distinguish between classic periostitis and a subperiosteal haematoma. In a histomorphological study of ossified subperiosteal haematomas and non-specific periostitis on the tibiae, the two were found to be distinguishable microscopically (Van der Merwe et al. 2010a). However, most research indicates that periosteal lesions are *typically* due to the inflammation associated with infection, and should be recorded as such, unless there is evidence to the contrary (Steckel et al. 2002, 89). While periosteal lesions are undoubtedly very common in archaeological skeletons, there are somewhat conflicting studies regarding its actual presence on bone. An histomorphological study of periosteal lesions has indicated that 'periostitis' may be over-diagnosed in macroscopic osteoarchaeological studies (Van der Merwe et al. 2010a). In their study of reactive bone in the tibiae, Van der Merwe et al (2010a) found that three cases of 'striations and possible slight subperiosteal bone' had no histological evidence of a pathological process. Such striations may routinely be recorded as healed periostitis, particularly in the tibiae. However, another study suggests that periositits may be under-diagnosed in archaeological samples, as well-healed examples may only be visible in radiographs (Weston 2008). In this study, any striations on the bone surface, which do not normally occur on the bone surface, were recorded as periostitis.

Goodman et al. (1984, 33) define a number of considerations in any assessment of infection in a population. These include:

- The use of narrow age-ranges in order to assess the range of susceptibility;
- Description of the location and severity of the lesions, and whether there are any indications of healing;
- Consideration of the synergistic relationship between infection, malnutrition, and cultural factors;

- Consideration of age and sex variations;
- The separation of non-specific and specific infections;
- Consideration of other stress indicators.

All of these factors were taken into consideration in this study. The exception was in relation to the age-ranges. Due to the nature of the assemblages, and the variation in preservation (see **Chapter 3**), it was not always possible to determine the age-at-death of all of the adults to a limited range. Therefore, analysis has concentrated specifically in differences and comparisons between the sexes.

While it is essential that Crude Prevalence Rates (CPRs, prevalence of disease by number of individuals) are recorded for populations, True Prevalence Rates (TPRs, prevalence rate by individual bone by number of observable bones) are essential in the detailed interpretation and in comparisons between populations (Roberts 2000b). Despite this, Roberts and Cox were not able to report TPRs in their study of health in Britain (Roberts and Cox 2003), as presumably the osteoarchaeological reports they examined varied in the manner of reporting. Conflicting reporting exists, even within individual osteoarchaeological departments or units. A Museum of London (MoLAS) report on the excavation of a nineteenth century cemetery at City Bunhill in London, representing a poor population with high Irish immigration, simply reported an overall crude prevalence rate (6.8%, 8/117) in relation to periostitis on the tibia and fibula, with no indication if other bones were involved (Connell and Miles 2010). Admittedly, the publication was perhaps never meant to be a detailed osteoarchaeological report, as it does form part of a series entitled 'Archaeological Studies'. In contrast is another MoLAS report on a wealthy eighteenth/nineteenth century cemetery excavated St Marylebone Church in London (Miles et al. 2008). This publication was a monograph, and the information on non-specific infections was far more detailed than in the previous report. Some reports only detail information on periostitis in terms of long bones (Adams and Colls 2007; Brickley et al. 2006). One recent British report provides precisely the type of data recommended by Roberts. This was a report on the skeletons of Royal Navy sailors and marines recovered in from the Royal Hospital in Greenwich in London (Boston et al. 2008), where detailed information was reported on both CPRs and TPRs.

As recommended by Roberts (2000b, 148) lesions in the present study were recorded by individual bone, as well as for overall numbers of individuals affected. This allowed for detailed assessment of the prevalence of bones involved, and if there were any particular parts of the skeleton that the lesions were confined. In addition, lesions were recorded for all bones, not just the limb bones, as this provides a broader overall picture of infectious stress in a population (Roberts 2000b, 149). Endocranial lesions were also recorded, where observable. The cranial bones, both endocranially and ectoncranially, are not covered with periosteum. However, bone deposits may still develop on and in the skull in relation in inflammatory responses of infectious processes (Boston et al. 2008; Lewis 2004).

In the seminal study on health in the western hemisphere, perhaps rather surprisingly, periosteal lesions were not differentiated in terms of active or healed (Steckel and Rose 2002). However, as mentioned above, evidence of healing is an important consideration in terms of assessing an individual's ability to withstand a physiological insult. As such, this study recorded all lesions as either active, healed, or a mixture of the two.

The prevalence rates that were examined in order to address the expectations detailed in **Section 7.6** include:

- Overall crude prevalence rate (CPR) in entire post-medieval group;
- Comparisons of crude prevalence rates with non-Irish populations, particularly of known class structure, and with Irish emigrant populations;
- Crude prevalence rates between the three groups;
- Crude prevalence rates of females and males, within groups and between groups;
- True prevalence rate (TPR) by bone, for all groups and by sex;
- Crude prevalence rates of healed lesions and active lesions;

The statistical package utilised to assess the data was Stata 10. Pearson's chi-square test was used to compare the crude and true prevalence rates. P-values of less than 0.05 were deemed significant, and all significant results are highlighted in bold in the tables where relevant. All data has been rounded off to one decimal place, apart from the data provided directly from Stata 10. In tables and figures, '*n*' refers to the numbers of individuals or bones with a specific pathological process, in this case non-specific infection, while '*N*' refers to the total number of observable individuals or bones.

The raw data on the non-specific infection analysis is provided in **Appendix Section 9.3**.

4.3 Workhouse Cemeteries

The Poor Law Union workhouses have already been described in **Section 3.3.3**. Cemetery samples from two workhouses were examined in the present study. The institutions were constructed primarily in the 1840s, under the Poor Law Act of 1838, in order to cope with the increasing levels of destitution in Ireland at the time. The workhouses replaced the traditional system of providing outdoor relief to those in distress with the institutionalisation of those in poverty. Essentially, the workhouse system was a 'final solution to the pauper problem' (Rose 1988, 58), ensuring that those in poverty were confined away from those that had the moral fortitude not to descend to that level.

4.3.1 Manorhamilton Workhouse, Co. Leitrim

Our Lady's Hospital in Manorhamilton currently occupies the site of the former Poor Law Union workhouse. The Poor Law Union of Manorhamilton was set up in October 1839, and the workhouse was constructed on the western outskirts of Manorhamilton town. It was a medium-sized workhouse, built to the standard regimented design, and intended to cater for 500 people (O'Connor 1995, 237; Rogers et al. 2006, 93). 'There were four principal buildings in all; the workhouse, a two storey stone lodge, a small infirmary and a fever hospital. Two inner walls, about 3m tall, and some ancillary buildings connected to the main buildings, formed an enclosed unit. The grounds were skirted by a gravelled avenue on the east side, circumscribing the lodge as far as a large yard at the rear of the workhouse and fronting the infirmary. This was the route of most activity such as the delivery of supplies and services. Accommodation for men was in the east wing while women and children were in the west. The wings were divided by a central section occupied by the Master's Quarters, kitchens, store rooms and laundries. A small chapel stood to the rear' (Rogers et al. 2006, 93-94). Burial grounds were located on either side of the hospital to the rear of the site (see **Figure 4.1**).

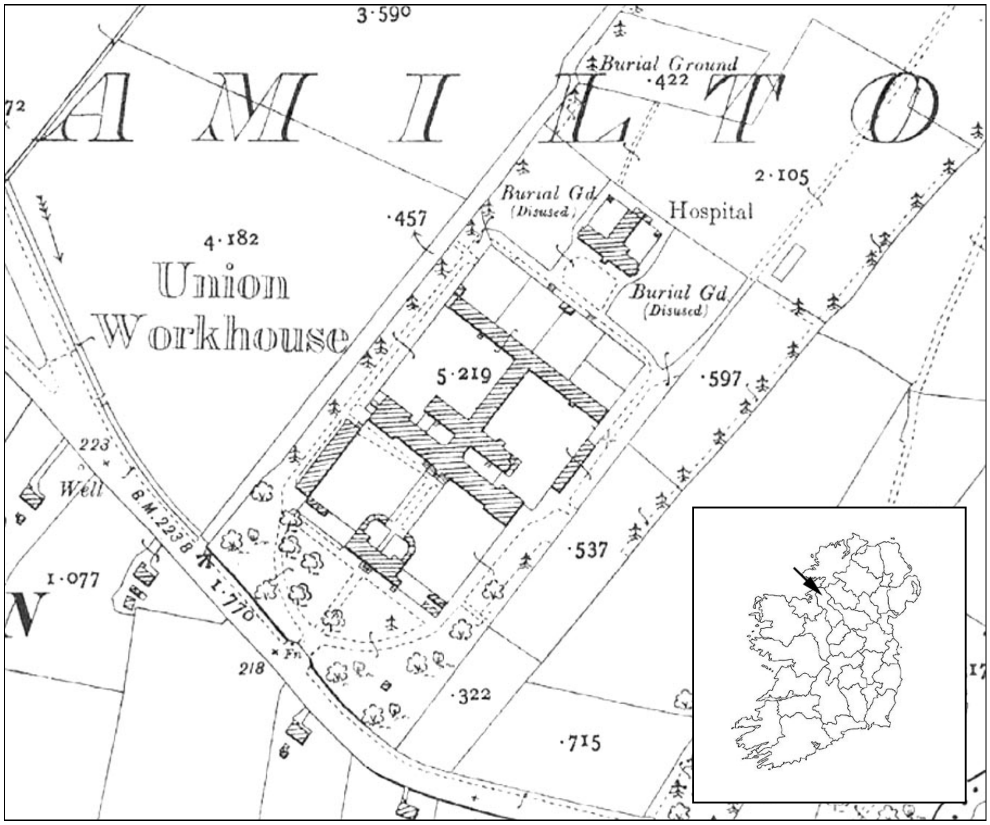


Figure 4.1.
Manorhamilton Poor Law Union Workhouse, late nineteenth century (2nd ed. 6"OS map (www.osi.ie), north to top), the excavated burials were recovered in the areas of the burial grounds marked on the map, directly to the northwest and southwest of the hospital

The institution admitted its first inmates on the 8th December 1842 (O'Connor 1995, 262). The first six people admitted were Pat Cullen aged 40, Hugh O'Donnell aged 20, Mary Hart aged 40, Mary Plunkett aged 50, Peggy Hyhan aged 80, and Ned Mitema (?) aged 80 (Rogers et al. 2006, 94). One week later, slightly more detail was recorded on those being admitted: Mary Murray orphan aged 18, Maigh Murray orphan aged 10, Mary Dolan orphan aged 12, Biddy Coyle deserted by husband aged 38, Mary Coyle child aged 10, Anne Clany idiot aged 40 (ibid.). Although built to accommodate 500 inmates, the workhouse remained under-occupied, even in the early years of the Great Famine. However by 1847, or 'Black '47', when levels of food-shortages and disease increased dramatically, the numbers of inmates increased to 767 (Rogers et al. 2006, 95). In May of that year, additional fever sheds were erected, in order to cope with the increasing numbers of people who were suffering from disease symptoms (O'Connor 1995, 244). As early as 1843 workhouse infirmaries were allowed to treat victims of fever, even if they were not destitute (Kinealy 1995, 109). Thus the general increase in disease in the 1840s, due to the prevailing famine conditions and the breakdown in social order, ensured that the numbers of sick individuals seeking admission to the workhouse increased accordingly. The numbers affected by fever remained high, with the total number of cases of fever standing at 193 in May of 1848. In that same year, the medical officer of Manorhamilton died of fever (Rogers et al. 2006, 95).

The prescribed food in the early years of the Manorhamilton workhouse varied only slightly from that devised by George Nicholls (see **Section 3.3.3**). Instead of the recommended 8 ounces of stirabout and half of pint of milk for breakfast, the inmates of Manorhamilton were to get 7 ounces of stirabout and either 1.5 pints of fresh milk or 1 pint of buttermilk. Dinner was the recommended 3.5 pounds of potatoes but the recommended 1 pint of skimmed milk was excluded (O'Connor 1995, 101; Rogers et al. 2006, 95). The latter may have occurred as a result of the increase in the milk recommendation for breakfast. Vegetables and meat were virtually non-existent. With the onset of the famine, potatoes were typically replaced with Indian meal. Some attempts were made to deviate significantly from the general prescribed diet. In June 1843 there was a proposal to allocate women and girls, who were engaged in hard labour, an additional six ounces of bread and a half pint of milk per day. The proposal was rejected on the grounds that the allowance of additional food to a particular group could disrupt the orderly running of the workhouse (Anon. 1839-44, 183; citied in Rogers et al. 2006, 95). However in April of 1847, additional rations *were* approved for boys by the guardians as they appeared physically weak and ill (Ó Gráda 1999, 102). This was surely an indication of the terrible conditions within the workhouse.

This workhouse finally closed in 1936 and the buildings remained larger unused until they were demolished in 1954 to make way for the construction of Our Lady's Hospital that currently exists on the site. The only surviving building from the workhouse period was a small fever hospital, built in 1849 in response to an expected cholera outbreak, and currently in use by the aforementioned hospital (Rogers et al. 2006, 95-96).

Neither the site of the workhouse, nor the one surviving building (the fever hospital), are recorded as RMPs. The latter building is listed on the National Inventory of Architectural Heritage (Registration Number: 30805030).

4.3.1.1 Excavation

Three coffined burials were uncovered in 2001, during construction work for a new North Western Health Board headquarters in front of the aforementioned former fever hospital (Moore and Rogers 2002). Subsequent archaeological testing, carried out by Declan Moore of Moore Group Ltd, revealed further burials on either side of the fever hospital. A 6m wide strip in front of the building was then subject to full excavation. Sixty-six individuals were excavated in the summer of 2001, while another seven inhumations were recovered in October 2002 (licence number 01E0720 plus extensions) (Rogers et al. 2006, 96). The present study used the 66 individuals that were excavated in 2001.

The preservation of the burials varied, with those on the west of the site in a better state of preservation than those in the east. Water-logging was a significant problem, and many of the bones were stained a bluish-grey from the clay matrix of the burial earth. The enamel of the teeth of a large number of individuals was blackened. Post-excavation analysis of these deposits by Dr Robin O'Sullivan, then of the Department of Anatomy in University College Cork, determined that it was caused by post-depositional factors. The burials were generally supine and extended, with arms extended parallel to the bodies. Rosary beads were recovered from three burials, while fabric recovered with some burials appeared to be remnants of shrouds. There are references to the latter in the workhouse minute books. Coffin remains were extensively evident. They were simply constructed, but solid. Some individuals appeared to have been buried on a bed of straw within the coffin (Rogers et al. 2006, 96). There are few direct references in the minute books of the workhouse to actual burials. Instead, references are primarily to requests for coffins, the demand for which increased significantly during the Great Famine. In July of 1848 33 deaths were recorded (Rogers et al. 2006, 96).

Evidence from the workhouse minute books indicate that the burials that were excavated by Moore Group Ltd date specifically between 1842 and 1848, as it is recorded that the first workhouse graveyard was full by 1848 (Rogers et al. 2006, 97).

4.3.1.2 Summary of Osteoarchaeological Analysis

A standard osteoarchaeological report (Lynch 2002) was completed on these individuals before their inclusion in the present study. The results of that former study are presented here.

The remains of 66 individuals were recovered from 61 graves during the first phase of excavations at Our Lady's Hospital in Manorhamilton, Co. Letrim. There were 47 adults and 19 juveniles. In the adult group there were 27 females and 19 males, while it was not possible to determine the sex of one adult. Poor preservation hampered the determination of the age-at-death of the adults, but there may have been a bias towards middle adults (25-44 years) and against young adults (18-24 years). However, it was only possible to determine the age-at-death of just over one-third of the adults, due to poor preservation. The ages-at-death of all of the juvenile individuals could be determined quite accurately and there was a noticeable lack of infants (<1 year).

An examination of the estimated living statures of this population indicates that both females and males may have been quite short, in comparison to their contemporaries.

The analysis of the dental remains of these individuals revealed high prevalences of calculus, caries, ante-mortem tooth loss, and periodontal disease. In addition a number of individuals had evidence of chipping and grooving of teeth, which may have been linked to accidents or occupational use of the teeth. A number of male individuals had evidence of being habitual pipe-smokers.

A variety of pathological lesions were observed on the skeletal remains. Joint disease was particularly prevalent and there were indications of variations in prevalences between females and males. Non-specific infections were also quite prevalent, particularly on the lower legs and ribs. A number of possible specific infectious processes were observed including sinusitis, middle-ear infection, as well as possible syphilis. Metabolic disorders such as iron-deficiency anaemia, vitamin D deficiency, and internal frontal hyperostosis were also recorded. The evidence of neoplastic disease was minimal and was exclusively in the form of a benign button osteomata. There were numerous instances of traumatic lesions. Quite a large number of individuals presented with healed fractures, particularly of the distal or lower sections of the arms and the legs. The ribs were also frequently affected, and the spines of a number of females had sustained fractures. Two individuals presented with evidence of serious trauma, one with massive trauma to the thorax and one with a broken neck, which was not a fatal injury. One individual had suffered bilateral subluxation of the shoulders. There were also examples of exotoses, os acromiale, osteochondritis dissecans, and spondylolysis.

A small number of congenital defects were also recorded, primarily in the form of minor joint defects. One individual however had abnormal asymmetrical formation of the nasal area of the cranium, with a minor cleft palate (Lynch 2002, 55-56).

4.3.2 Cashel Workhouse, Co. Tipperary

The extant remains of Cashel workhouse are currently occupied by St Patrick's Geriatric Hospital. Cashel Poor Law Union was established in January 1839 and contracts for the construction of the Union workhouse were signed in 1840, although the building was not completed until December 1841 (Lonergan 1992). The first inmates were admitted on the 28th January 1842 (O'Connor 1995, 260). The workhouse was medium in size and was designed to cater for 700 individuals (see **Figure 4.2**) (O'Connor 1995, 80, 260). It followed the standard layout of all of the Poor Law Union workhouses, with a fronthouse and a main building. The front building contained a Boardroom, a clerk's office and a porter's room, probationary and vagrant wards, and outhouses including privies, washing room, and refractory cells. The main building was three storeys high. The west side was designated for females and the east side for males. Interestingly, the latter division is still retained in the modern-day hospital (Lonergan 1992, 7). A fever hospital was constructed in 1845 in direct response to a rise in the occurrences of fever, and it was extended in 1847. Essentially, Cashel workhouse, like others, was extended as needs demanded, either by the construction of additional wards, or the renting of extra properties as auxiliary workhouses. The latter included Canopy Street, Lower Gate, Blindstreet, Power Stores, Richmond House, and Castlelake (Lonergan 1992, 53). As with Manorhamilton workhouse, Cashel also got rid of its idiot wards in 1847 (O'Connor 1995, 240).

Although designed to cater for 700 individuals, like most workhouses, Cashel was under-occupied in the early years. However, by May 1847 the Board sought accommodation for an additional 170 people (O'Connor 1995, 234). Inmate numbers rose exponentially as the

Great Famine dragged on for years. The peak number of inmates in Cashel was recorded 1851 at 4,869 individuals (Lonergan 1992). This high figure must surely have included individuals in the ancillary workhouses as well. The scale of destitution in Cashel is indicated by the events of late 1846, traditionally considered a year that was not as devastating in terms of death and disease in the Great Famine. By the end of 1846 the workhouse began supplying outdoor relief to the paupers who could not be admitted to the workhouse due to overcrowding (Lonergan 1992, 24). The workhouse continued to support both the 1045 individuals now in the workhouse and 245 people outside: however, the latter was in direct contravention of the Poor Law (Lonergan 1992, 25). In fact, Cashel was the only Union that steadfastly refused to adhere to the letter of the law and the only Union to which the Poor Law Commissioners had to issue a sealed order on the 8th December 1846 to cease and desist from administering outdoor relief (Lonergan 1992, 26). The situation deteriorated so much that finally the Commissioners did authorise the Guardians in Cashel in January of 1848 to provide outdoor relief, in the form of Indian meal and for a minimum of eight hours work a day (Lonergan 1992). The favoured form of work was stone-breaking.

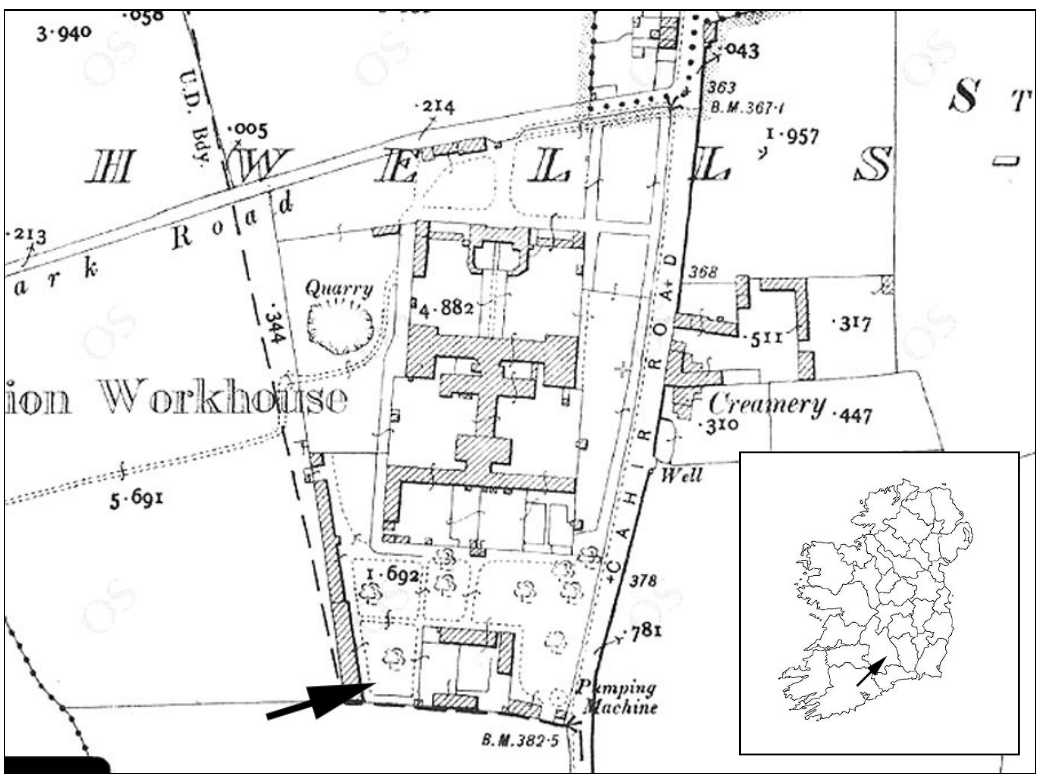


Figure 4.2.
Cashel Poor Law Union Workhouse, late nineteenth century (2nd ed. 6"OS map (www.osi.ie), north to top), skeletons were excavated in arrowed area

On opening, the initial diet followed that as recommended by the Poor Law Commissioners (see **Section 3.3.3**). However, as with other workhouses, the quality and quantity of food provided in the workhouse changed dramatically with the appearance of the Great Famine. As early as the first six month of 1846 the primary diet in the Cashel workhouse was bread and milk, with some Indian meal (Lonergan 1992, 23). This is despite the fact that the famine had not yet fully taken hold. The strain the workhouse was under in the years of the Great Famine is well illustrated in the minute books. The Matron of the workhouse recorded that 'the Indian meal is very bad, several classes got no dinner on the 25th, 26th and 27th of December 1847'. Just over 10 years later however, in 1858 Mr John Davis White, a member of the Visiting Committee, recorded that on Christmas day 'I saw all the paupers were served with a plentiful dinner of most excellent beef and vegetables with bread and soup'. This was a stark contrast to the Christmas of 1847. By 1884 the Christmas diet comprised tea and bread for breakfast and a pig's head and potatoes for dinner (Lonergan 1992, 37, 97, 143). (This reflects the influx of certain groceries, which previously had been reserved for the wealthy, into the common diet of even paupers by the second half of the nineteenth century. In addition, in the post-famine period fatty bacon came to form an important part of the common diet (Clarkson and Crawford 2001, 236-238). The pig's head was essentially the leftovers from the butchered pig. As with the earlier decades, vestiges of the everyday diet of the Irish were apparent in that of the workhouse, but with reduced quality).

The traditional recognised burial ground for Cashel workhouse is St Mark's cemetery, located just under 2.5km to the south-west, as the crow flies, on the Clonmel road. It is not marked on the first edition Ordnance Survey map, dating to the 1840s, whereas the workhouse is indicated. By the time of the second edition OS map, dating to the later nineteenth century, both the Union burial ground and the workhouse are indicated. This suggests that in the earliest years of the workhouse, there was no designated burial ground. In the early years of the workhouses, many of the institutions undertook burials within the boundary walls. It was only with the onset of the Great Famine, and the dramatic increase in mortality within the workhouses, that specific burial grounds outside of the workhouses were sought. Therefore, many intermural burials may be expected to date to the early decades of use of the workhouses, and particularly to periods of increased stress on the system, such as during the Great Famine and the numerous fever epidemics in that period also.

As with most other workhouses, Cashel gradually took on the role of a hospital. In January 1877 the Infirmary Nurse resigned. As a direct result the Sisters of Mercy were invited to take up nursing duties in the workhouse. By 1894 the workhouse was being referred to as 'St Patrick's Hospital' (Lonergan 1992, 152). It has continued in that role, with the utilisation of most of the original workhouse core buildings by the hospital. It is currently operating at St Patrick's Geriatric Hospital.

The site and buildings of the workhouse (the latter are largely extant) are not listed as an RMP. The building is listed on the National Inventory of Architectural Heritage (Registration Number: 22105082).

4.3.2.1 Excavation

Excavations were undertaken immediately to the southwest of the extant workhouse buildings, currently in use as St Patrick's Geriatric Hospital, by Mary Henry Archaeological Services Ltd in 2007 (licence number 07E0913) (Henry 2010). The excavation was necessitated by the uncovering of previously unrecorded inhumation burials by construction works associated with an extension to the current building (ibid.).

A total of 45 burials were uncovered and excavated. All skeletons were lying supine (on the back) and extended, with the head to the west. The graves were arranged in regular rows. The excavations were confined to a small area and it is likely that there are more burials outside of the excavated area (Henry 2010; Lynch 2008). The burials were in an excellent state of preservation.

Cartographic data suggests there was no designated cemetery in the earliest years of the Union workhouse. The excavated burials were located immediately to the southwest of the extant workhouse buildings. Although it is difficult to be certain, given the limited nature of the excavation, it is possible that the present burials were located immediately outside of the western boundary wall of the 1840s workhouse. Certainly by the late nineteenth century there was a designated burial ground (St Mark's, see **Section 4.3.2**). Therefore the excavated burials are likely to date to the period of the Great Famine, or at least to a period of increased pressure on the workhouse system, such as a fever epidemic.

4.3.2.2 Summary of Osteoarchaeological Analysis

A standard osteoarchaeological report (Lynch 2008) was completed on these individuals before their inclusion in the present study. The results of that former study are presented here.

In total, 45 skeletons were recovered during the excavations at St Patrick's Hospital. There were 20 adults and 25 juveniles. There was a possible bias towards older aged adults (35+ years) and young juveniles (6< years). Six infants, aged less than 1 year at the time of death, were recovered, and one was a full-term infant while another was a pre-term infant. In the adults there were slightly more male adults than females.

An assessment of the adult statures indicated that both the females and males were smaller in stature than their contemporaries, a medieval group, and the modern average stature.

Dental remains were recovered with almost all burials. In the adults there were high levels of ante-mortem tooth loss, calculus, carious lesions, abscesses, and periodontal disease. Enamel hypoplastic defects were recorded in the dentitions of two adults, while three adult males had lesions indicative of habitual clay-pipe smoking. Most of the aforementioned diseases and conditions were recorded also in the juvenile dentitions, with the exception being the evidence of clay-pipe smoking. The rates of calculus and caries were again high. Abscesses and periodontal disease were recorded on a single juvenile individual, the only adolescent, whose teeth were severely deformed by caries, ante-mortem tooth loss, and periodontal disease. Unusual congenital defects were also present in the skeletal remains of this individual and research is ongoing.

Joint disease was the most common pathological lesion present on the skeletal remains. It was observed in 95% of adults, the exception being an individual whose skeletal remains were severely truncated post-deposition. The most common location of degeneration was in the spine. The females appear to have had a higher prevalence of DJD (degenerative joint disease) than males. The prevalence of osteoarthritis increased with age. Joint disease was present in a single juvenile (the adolescent).

Lesions of non-specific infection, primarily in the form of periostitis, were common in both adults and juveniles. A single case of possible osteomyelitis was also identified. In most instances the lesions were non-specific in nature, although may have been secondary to traumatic insults. In the juveniles the lesions were particularly prominent in the endocranial or internal surface of the cranium. It is likely that many of these cases may be related to problems occurring at birth. One likely case of osseous tuberculosis was identified in a child.

There were some limited examples of metabolic conditions in this population. Porotic hypersotosis and cribra orbitalia were identified in some adult male individuals, but no cases were present in the female adults. Cribra orbitalia was present in a number of juvenile individuals. Lesions on two juveniles were tentatively identified as vitamin C deficiency or 'scurvy', while one adult female may also have suffered from scurvy in childhood.

A number of instances of healed traumatic fractures, sustained during life, were apparent in the adults, with a higher prevalence in males. A single female adult had multiple fractures, possibly originating from a single accident. In the male group, three in particular had suffered serious fractures. One individual had a fractured knee, which resulted in fusion of the knee and a considerable lack of mobility. Another male had, among other fractures, a depressed fracture to the skull which may have resulted in neurological problems. Another male had suffered a serious fracture to the lower leg, which did not have traction applied and which resulted in severe deformity and shortening of the left leg.

A variety of congenital defects were identified. There were both spinal and extra-spinal defects, and these were identified in both adult and juvenile remains. In general the abnormalities were relatively mild in severity. However, a noticeable and severe exception was an extreme case of scoliosis (spinal curving), which would have had considerable impacts on at least the physical well being of the individual.

A probable case of bilateral popliteal aneurysm was identified. There were also lesions recorded in two other individuals, the aetiology of which has yet to be determined (Lynch 2008, 55-57).

4.4 Middleclass Cemeteries

Skeletons from five cemeteries were grouped together for the present study on the basis that they were likely to represent individuals largely from the Protestant middle classes of the post-medieval period. The sites included skeletons from the Cathedral of St Mary the Virgin and St John the Baptist in Sligo, St Mary's Church in Clonsilla in Dublin, St Fachtna's Cathedral in Rosscarbery in Co. Cork, Church Street in Finglas in Dublin (associated with St Canice's Church), and St John's Lane in Waterford City. The latter site was Quaker in origin, while the other cemeteries were Church of Ireland establishments. Both St Mary's in Clonsilla, and Church St., in Finglas, would have essentially been rural locations for much of the period of use of the cemeteries in question. St Fachtna's in Rosscarbery could be classed as such also. Sligo town would have been a larger, more urban settlement than the previous three sites in the eighteenth and nineteenth century, while the Quaker cemetery in John's Lane in Waterford, was located well within the urban environment of the city. However, the low numbers of individuals recovered from each of these sites ensured that, as an individual unit, none of the sites could be used as representative sample. Therefore the five sites have been pooled into a single sample in the analysis for this study, and are taken as broadly representing the middleclasses in post-medieval Ireland. The sites are all examined below, with general historical backgrounds, information on the excavations, and a summary of the osteoarchaeological findings.

4.4.1 Cathedral of St Mary the Virgin & St John the Baptist, Sligo

Traditionally, the site of St Mary the Virgin and St John the Baptist is believed to be the location of a medieval hospital and parish church, founded in the thirteenth century in honour of the Trinity (Sligo Cathedral Group 2013). Architectural appraisal of features contained within the present Church of Ireland church on the site reveal remnants dating to the twelfth century (NIAH 2013c). Following initial incursions by the Anglo-Normans, Sligo reverted to an Irish settlement under the O'Connor's after the Bruce invasion in the early fourteenth century, and it remained as such until late into the Elizabethan period (O'Rorke 1986, 300). Following the Reformation, the first evidence of the use of this church site by Protestants dates to 1615 (O'Rorke 1986, 314). In 1689 the Protestants of Sligo gathered to hold the town for King William III, but later surrendered to Patrick Sarsfield. Although the Jacobites held the town for two years, it was surrendered back to William III in 1691 (Simms 1961, 153). The present church (**Figure 4.3**) was designed by architect Richard Cassel and was completed in *circa* 1730. That architect was also responsible for the palladian Russborough and Powercourt Houses, both in County Wicklow, as well as for the Dublin townhouse of the Earl of Kildare, Kildare House, now know as Leinster House and present seat of both houses of the *Oireachtas* or parliament of Ireland. In the 1830s St John's was described as 'an old cruciform building, in excellent repair, in the later style of English architecture, with a massive square tower at the west end' (Lewis 1837b, 570). Even in the eighteenth century, Sligo county had the highest proportion of Protestants in any county outside of Ulster (Simms 1961, 156). From an estimated 4000 inhabitants in the mid-eighteenth century, fifty years later the population of Sligo had increased to an estimated 8000 (Simms 1961, 156, 161). Indeed, by 1819 the population of Protestants in Sligo had grown to such an extent that St John's church was too small, and another church was built in Calry to accommodate the additional worshippers (O'Rorke 1986, 318). Despite the increase in the Protestant population, Sligo remained on the periphery of the world of the Ascendency, particularly as there were no resident nobility (Simms 1961, 153). The parents of William and Jack B. Yeats were married in this church in September 1863, while their young brother Robert C. Yeats, aged 3 years, and their maternal grandparents, the Pollexfen's, were interred in the adjoining graveyard (Sligo Cathedral Group 2013). St John's became a Cathedral in 1961 when, following severe storm damage to the Cathedral church for the dioceses of Elphin and Ardagh in Elphin, the Seat of the Bishop of Elphin and Ardagh was transferred to St John's, when the church was renamed the Cathedral Church of St Mary the Virgin and St John the Baptist (ibid.).

Two RMPs are recorded for this site. The church is recorded as **SL014-065010-**, while the location is also recorded as the site of a hospital, **SL014-065003-**. The church building is listed on the National Inventory of Architectural Heritage (Registration Number: 32007085). St Mary's Roman Catholic cathedral is located directly to the west of the St Mary the Virgin and Saint John.

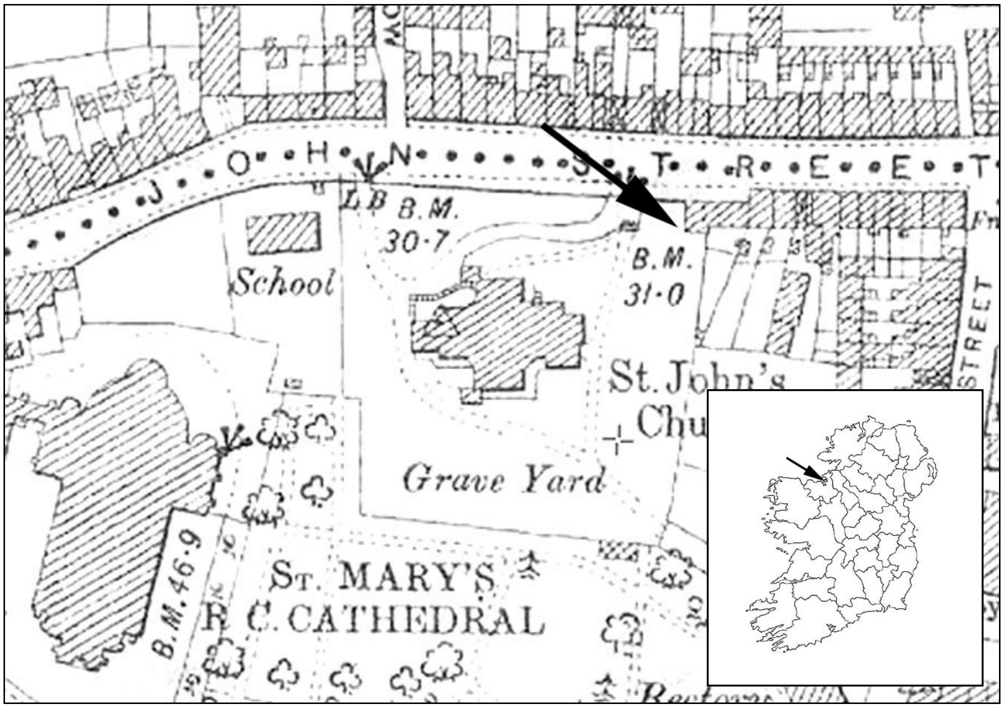


Figure 4.3.
Cathedral of St Mary the Virgin and St John the Baptist (CoI), Sligo town, centre of image, late nineteenth century, with RC Cathedral immediately to southwest
(2nd ed. 6"OS map (www.osi.ie), north to top),
approximate location of excavated skeletons arrowed at northeastern edge of burial ground

4.4.1.1 Excavation

In 2000 planning permission was granted to develop part of the cemetery in the northeastern limit of the burial ground associated with St Mary the Virgin and St John the Baptist, subject to archaeological monitoring. Sixteen inhumation burials were uncovered during these works. Fifteen of these individuals were re-buried without osteoarchaeological analysis in the grounds of the existing cemetery (the sixteenth individual was reburied at a later period, see below). Works were suspended for a period of time and various meetings were held between the relevant authorities. Further archaeological excavations were then undertaken and 33 more burials were uncovered. Thirty two individuals were submitted for osteoarchaeological analysis. The unanalysed burial was a named individual, Mrs Day, the wife of the Reverend Day. She, along with the lead coffin of Rev. Day, and one other individual recovered during the initial stage of archaeological monitoring, were reburied in the grounds of the present cemetery (Reverend Day had resigned his position in 1876, and died ten years later on the 23rd July, aged 83 years (O'Rorke 1986, 315-6)). Thus just 32 of the total of 50 individuals uncovered were subject to osteoarchaeological analysis. A series of pits, containing occupation debris, underlay the burials, and this occupation layer was dated to the eighteenth century. Gravemarkers in the area indicate burials continued until the early twentieth century (Lynch 2001; Ryan 2001; Ryan 2003). Therefore the excavated burials date from the late eighteenth century to the early twentieth century. The remains were generally in an excellent state of preservation. The on-site archaeological works were undertaken by Frank Ryan of Mary Henry Archaeological Services Ltd (licence 01E0207).

4.4.1.2 Summary of Osteoarchaeological Analysis

A standard osteoarchaeological report (Lynch 2001) was completed on these individuals before their inclusion in the present study. The results of that former study are presented here.

Thirty-two individuals from St Mary the Virgin and St John the Baptist were examined by the writer. In agreement with the National Museum of Ireland, the osteoarchaeological study consisted of a very basic analysis of the skeletal remains. It included the compilation of a basic catalogue, and the determination of age-at-death, sex, and stature of each individual, where relevant. In addition, the writer cleaned, examined, and recorded, the dentition of each individual (Lynch 2001).

Thirty two skeletons were examined. There were 30 adults and 1 juvenile. In the adults there were 11 females and 13 males, while it was not possible to determine the sex of 7 adults. Over half of the adults were aged between 26 years and 45 years at the time of death. It was not possible to determine the age-at-death of 11 adults. The juvenile was aged between 1 year and 1.5 years at the time of death.

Dental remains revealed the presence of calculus, carious lesions, enamel hypoplastic defects, abscesses, periodontal disease, as well as the ante-mortem loss of a number of teeth. A set of maxillary dentures were also recovered.

Evidence of degenerative joint disease was observed in both the axial and appendicular skeleton of a number of individuals. There was one possible case of ankylosing spondylitis. Numerous healed fractures were noted, mostly on the long bones, although a healed depressed fracture was present on the skull of one individual. Most of the fractures were well healed with little misaligment, although one fracture resulted in a severe abnormality of the upper arm.

Traces of infection were noted on a number of individuals. Occurrences of *os acromiale* and spondylolysis were noted and these may be related both to congenital and traumatic factors.

Two skulls display evidence of having been surgically removed while another skull had at least two trepanations preformed. (Lynch 2001, 26-27).

4.4.2 St Mary's Church, Clonsilla, Dublin

Clonsilla is located approximately 10km to the northwest of Dublin. The site has ecclesiastical origins stretching back to at least the thirteenth century, although the present Church of Ireland church is nineteenth century in date. Although now part of the suburbs of Dublin, it was a rural location for much of its history. Throughout the history of the Anglo-Norman's, and later the English, Clonsilla was located within the area known as 'the Pale', which remained under English control throughout the medieval period. The present Church of Ireland (**Figure 4.4**) establishment at Clonsilla, St. Mary's, was constructed in 1846 (NIAH 2013c). It is however, on the site of older churches, with associated burials, with one graveslab in the surrounding graveyard dating to 1687 (see below). Prior to the sixteenth century the primary church of Clonsilla was located at Coolmine. After the dissolution however, the site of the present church became the primary place of worship (Ball 1979a, 20). While there are few details on when a church was first constructed here, in 1615 it was described as being in good repair, while just 15 years later it was in a ruinous state. The antiquarian Austin Cooper visited the church at the end of the eighteenth century. He described it as a small, plain, neat structure with an attached building (ibid.). Tradition records that the chancel of that church was surrounded by four square pews, which were used by the principal members of the congregation (Ball 1979a, 21). All traces of earlier churches were obliterated with the construction of the present church. There are not a lot of records regarding these earlier churches. However, it is known that the church and graveyard were enclosed by a wall in 1796 by church warden Robert Wynne (Priestley 2009, 27). This allowed the church to increase the price for burial within the church yard to 3s and 3d for parishioners and twice that for non-parishioners (ibid.). All burials were also to be five feet deep.

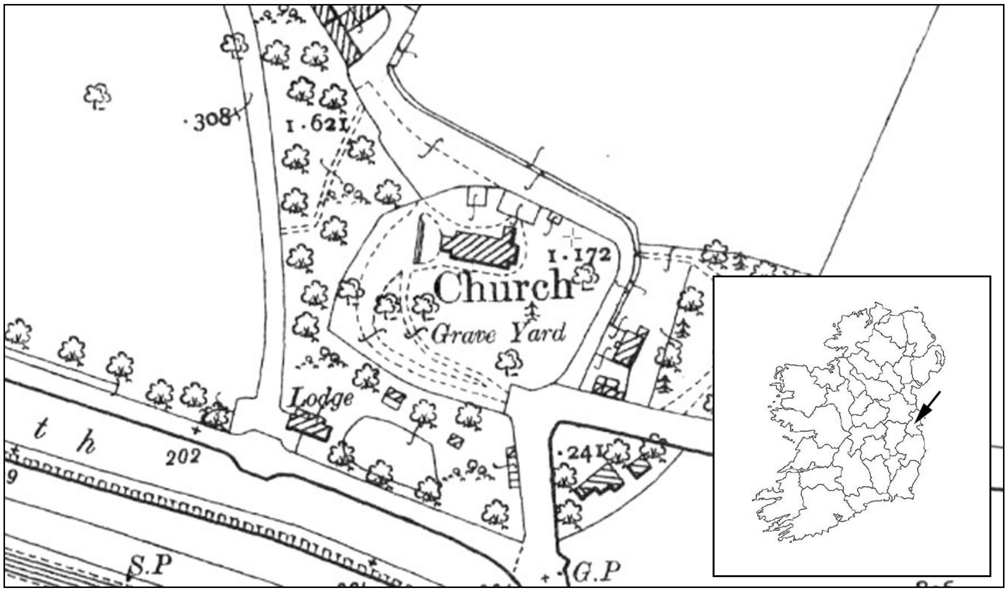


Figure 4.4.
St Mary's Church, Clonsilla, late nineteenth century (2nd ed. 6"OS map (www.osi.ie), north to top)

The history of Clonsilla is intimately linked with the Luttrell family and Luttrellstown Castle, located 1.5km to the southwest of the St Mary's church. During the Dissolution in the sixteenth century, the Right Honourable Sir Thomas Luttrell, Chief Justice of the Common Pleas in Ireland got the lands of St Mary's Abbey, which included Clonsilla. He died in 1554 and was buried in Clonsilla. He specifically requested that an extension be built to the church to accommodate his tomb. It is surmised that this is what Austin Cooper observed in the eighteenth century, see above (Ball 1979a, 4, 20). The estate was lost during the Cromwellian wars to Colonel John Hewson but was restored to the Luttrell's in 1663 (Ball 1979a, 12). Just before this, the population of Clonsilla village was recorded as 42 individuals of English birth, and a further 87 Irish natives (ibid.).

Soon the Luttrell's developed an unsavoury reputation. By the end of the seventeenth century the Luttrell's, under Colonel Simon Luttrell, supported James II. The Colonel died in 1698 and he was succeeded by his brother, Colonel Henry Luttrell. That Luttrell notoriously switched the family loyalty to William III. This betrayal was deeply felt by the native Irish in Clonsilla. By the time Henry was murdered in 1717 he had converted to Protestantism (Ball 1979a, 14-16). Henry's son, Simon was perhaps the most notorious of the Luttrell's. Simon Luttrell, the first Earl of Carhampton in the eighteenth century, was a member of the legendary Hell Fire Club. Legend tells that he sold his soul to the devil in return for the overnight construction of a mill (Priestley 2009, 16). The same individual also narrowly escaped conviction for the abduction and rape of a child (ibid.). Simon's son Henry, the second Earl of Carhampton, became despised by the native Irish for his enthusiastic suppression of the 1798 rebellion (Ryan 2012, 64). He clearly had a poor reputation even before that, as he survived an assassination attempt in 1797 (Priestley 2009, 30). He was reputedly involved in the detention of 1000 rebels in the Connaught area in 1798, who were subsequently press-ganged into the Royal Navy (Ryan 2012, 64). In fact, in apparently a direct response to those actions, the tomb of his grandfather Henry (murdered in 1717) was desecrated and his skull smashed (Ball 1979a, 17; Priestley 2009, 50). Following the rebellion, the Earl moved back to, and remained at, his estates in England, where he died in 1821 (Priestley 2009, 53-54). The lack of respect he was held in is well illustrated by the fact that when the *Dublin Evening Post* mistakenly reported his death on 5th May 1811, their retraction of the story was entitled 'Public Disappointment' (Priestley 2009, 54). The Luttrellstown estates were sold to Dublin bookseller Luke White at the turn of the nineteenth century, who renamed it Woodlands (Priestley 2009, 53; Lewis 1837a). This was probably an attempt to eradicate the legacy of the Luttrell's, although that family name has been reapplied to the estate in modern times. Much of the spectacular present house is attributed to improvements by White (Guinness and Ryan 1971, 139-140). Interestingly, despite the coloured reputation, the Luttrell's were held in high esteem by the local gentry, which possibly enticed wealthier individuals into the area. It has been noted that many of the headstones in the graveyard of St Mary's reveal that many individuals were not born in that parish (Priestley 2009, 54).

Three RMPs are recorded adjacent to the development site. The church is recorded as **DU013-017001-**, the graveyard is **DU013-017002-**, while a graveslab on the site is also a recorded monument, **DU013-017003-**. The church building is listed on the National Inventory of Architectural Heritage (Registration Number: 11353005).

4.4.2.1 Excavation

Excavations were undertaken in 2004 in advance of a proposed extension to the church. The excavations were carried out by Sian Keith of National Archaeological Services Ltd (licence number 02E1422) (Keith 2007). A total of 32 burials were uncovered, dating from the nineteenth through to the early twentieth century. Twenty-three of these skeletons were available for analysis.

4.4.2.2 Summary of Osteoarchaeological Analysis

All of the skeletons from Clonsilla were examined by the writer in full prior to their inclusion in the present study. The results of that former study are presented here.

A total of 23 skeletons were available for analysis. These comprised 10 adult and 13 juveniles. Seven of the adults were male while there were just two females in the sample. It was not possible to determine the sex of a single adult, nor was it possible to determine the age-at-death of that individual. Eight of the other adults were aged 35 years or older at the time of death. One female was between 17 years and 20 years at the time of death. Four of the juveniles were infants and included a pre-term infant and full-term infant, while five juveniles were aged between 1 year and 6 years at the time of death.

Dentitions revealed the presence of calculus, caries, abscesses, periodontal disease, and hypoplastic defects in all observable adults. The high prevalence of all of these may be related to the older ages-at-death of many of the adults. Calculus was also identified on the dentitions of a number of juveniles, while the teeth of two juveniles had suffered severely from carious lesions.

Degenerative joint disease was identified on the remains of all observable adults, with one individual suffering from osteoarthritis. Evidence of inflammatory lesions were present in five adults and in one juvenile. One of the adults had suffered from a severe destructive pathological process in the mandible. Evidence of metabolic disease was also relatively common in the adults, with porotic hyperostosis and/or cribra orbitalia present in six individuals. Only one juvenile had similar lesions. Four adults had sustained traumatic injuries, with three of those being hairline fractures, possibly related to repeated stresses. The fourth individual had a dislocation right shoulder and four fractured ribs. One juvenile had suffered a broken finger. Os acromiale, a popliteal aneurysm, and enthesopathies were also present.

4.4.3 St Fachtna's Cathedral, Rosscarbery, Cork

St Fachtna's Church of Ireland cathedral (**Figure 4.5**) is the smallest in Ireland, and has been the chair of the Bishop of Ross since the twelfth century (Webster 1927, 5). St Fachtna is believed to have founded a house here in the sixth century, possibly on the site of the present cathedral (Webster 1927, 5). The foundation became a noted place of learning

(Lewis 1837b, 534). The first recorded church at this site dates to the tenth century, although no trace of that structure remains. In 1582 it was recorded that a church was under construction at the site, presumably as a replacement of an earlier structure. In 1641 the nave and the tower were levelled, leaving the choir and two chapels intact (Webster 1927, 7). In 1837 the church was described as having been 'rebuilt in 1612: it was a handsome structure, in the later English style, with a lofty square tower, which in 1806 was surmounted with an octagonal spire of hewn limestone…; the church is now being rebuilt on an enlarged scale by the addition of a south transept, which will render it perfectly cruciform' (Lewis 1837b, 535). At least some elements of today's cathedral can be dated to the sixteenth century, although the present structure dates largely to the extensive refurbishments in 1876 (NIAH 2013b). The church and graveyard are located on the eastern side of Rosscarbery town, with panoramic views over the mudflats of the estuary leading into Rosscarbery Bay.

The town of Rosscarbery had its foundations in an ecclesiastical settlement, and a walled town developed there. This settlement however, suffered considerably during native Irish conflicts and the town was in decline by the twelfth century and the Anglo-Norman invasion (Lewis 1837b, 534). Rosscarbery, along with the surrounding area, was then granted to the Fitz-Stephen family (ibid.). Rosscarbery itself, despite being largely English in composition, lay within a Gaelic area. In 1517 it was a substantial settlement, and was described as a walled town with two gates, and approximately 200 houses (O'Brien 1993, 131). By the seventeenth century however, the fortunes of the settlement appear to have declined, and the town appears to have suffered significantly during that turbulent century. During the Confederate Wars in the 1640s, the daughter of the then Bishop Lyon was murdered in the nave of the church, an indication of the bloodshed which was widespread at the time (Webster 1927, 7). By then the town was described as having just two short streets and less than six substantial houses (O'Flanagan 1993, 353). The later development of Rosscarbery was largely linked with the gentry family of the Freke's. By the eighteenth century industrial and economic developments had made an impact on the town, with 'aspirations of prosperity' (ibid.). There with a new market house, market place, a fair green, and a minute pond. The dedicated market place was exceptional in terms of other contemporary towns and contributed significantly to the growing prosperity of the town (O'Flanagan 1993, 353, 419). In addition, the improvement in road networks in the nineteenth century, encouraged the development of the town in terms of recreational amenities (O'Flanagan 1993, 453). However, Roscarbery could never take full advantage of its location by the sea due to the excessive mudflats. Although linen manufacturing had been a very important industry in the town, it was well in decline by the 1830s, and the main source of employment was in agriculture and fishing (Lewis 1837b, 534). Despite the apparent air of general prosperity in the town in the eighteenth and nineteenth centuries there was the inevitable poverty. In 1786 the Reverend S. Jervois bequeathed £400, 'the interest of which is annually divided among the Protestant poor' (Lewis 1837b, 536). In addition, although the central square of the town and the surrounding houses were certainly prosperous in appearance, in reality there was a ratio of three cabins to every house, with a cabin representing one of the lowest forms of habitat (O'Flanagan 1993, 413).

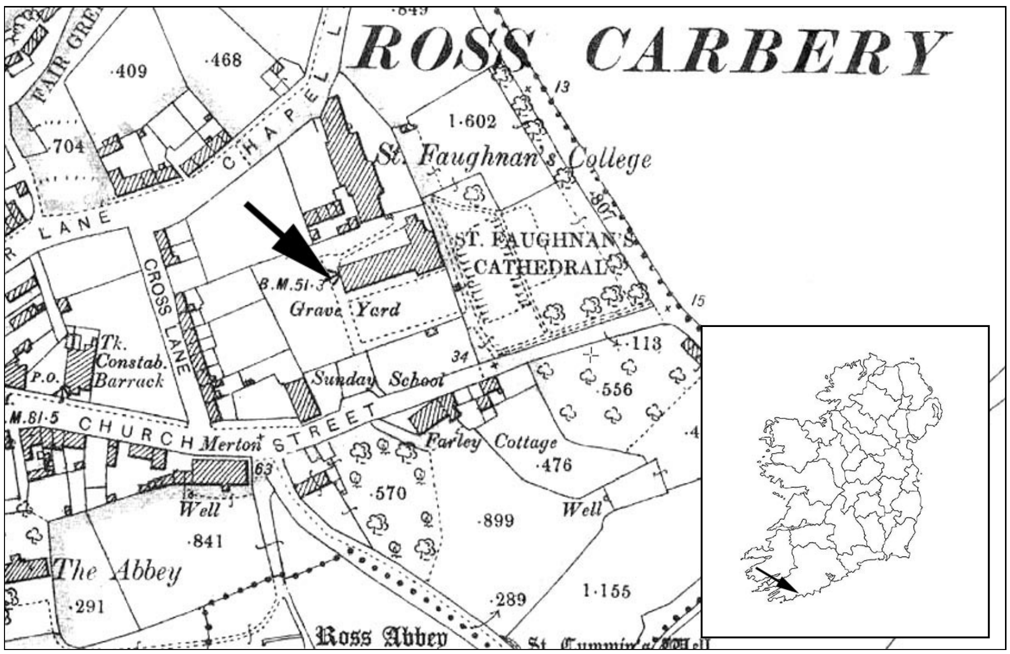


Figure 4.5.
St Fachtna's Church of Ireland Cathedral, Roscarbery, late nineteenth century (2nd ed. 6"OS map (www.osi.ie), north to top), location of excavated burials arrowed

There are four RMPs recorded for this site. The cathedral and graveyard are recorded as **CO143-023008-** and **CO143-023007-** respectively, while two fonts are present in the floor of the cathedral. These are recorded as **CO143-095---** and **CO143-096---**. The cathedral building is listed on the National Inventory of Architectural Heritage (Registration Number: 20855029).

4.4.3.1 Excavation

Restoration projects have been ongoing at the cathedral since 2002 (NIAH 2013b). Assessments ascertained that damage was being caused to the fabric of the building as a result of poor drainage around the cathedral itself. During the monitoring of the new drainage channels, burials were located orientated west/east at the exterior of the western gable of the cathedral. Portions of 13 burials were exposed and excavated. Each burial was coffined, and three were located within stone-lined graves. Excavation indicated that the burials date to the late seventeenth/early eighteenth centuries. The excavation was undertaken by Mary G. O'Donnell of the Archaeological Services Unit, then attached to University College Cork (licence number 03E0186) (O'Donnell 2007).

4.4.3.2 Summary of Osteoarchaeological Analysis

All of the skeletons from St Fachtna's were examined in full by the writer prior to their inclusion in the present study. The results of that former study are presented here.

The analysis of the skeletons from St Fachtna's was somewhat hindered by the limitations of the excavation. Due to the confines of the trench only portions of skeletons could be excavated. Thirteen burials were identified. All appeared to be adults, but six in particular were very poorly preserved, and as well as being incomplete had suffered significant fragmentation and erosion. There were at least five males and four females in the sample. It was only possible to determine the age-at-death of four individuals, and all of those were aged between 30 years and 40 years at the time of death.

No dental remains were recovered.

At least five individuals had evidence of degenerative joint disease, with three of those exhibiting eburnation that is traditionally associated with osteoarthritis. One individual had evidence of non-specific infection. In terms of traumatic lesions, one male had a fractured left rib, while another male had suffered subluxation of the right first proximal foot phalanx. A possible case of gout was identified, while the aetiology of lytic foci in the remains of a male could not be determined. A large depression was present in the superior body of the third lumbar vertebra of one adult, but was not representative of the typical manifestations of the depressions associated with Schmorl's nodes. The spine of that individual had also massive osteophytic formation suggestive of diffuse idiopathic skeletal hyperostosis (DISH).

4.4.4 Church Street, Finglas, Dublin

A site recently excavated at Church Street in Finglas represents primarily post-medieval activity associated with the medieval church of St Canice, which was located directly to the east (Kavanagh 2007). It was in use as a Church of Ireland church until the 1840s (see **Figure 4.6**).

A monastery was founded in Finglas in the sixth century by St Canice (Ball 1979b, 84). The present ruined church dates to between the tenth and twelfth centuries, and was in use until the 1840s as a Church of Ireland church (Robinson 2005, 9). In 1630 the church was reported as being in very good repair with a large congregation. However, the tumultuous years of the mid-seventeenth century ensured that the church required restoration in the latter part of the century (Ball 1979b, 118). In 1779 Austin Cooper visited the site (the same individual who had also visited St Mary's Church in Clonsilla, see **Section 4.4.2**), and said that it was a 'neat pretty church', and that the chancel was decorated with panels with the Lord's Prayer, the Creed, and the Ten Commandments in gilt letters (Ball 1979b, 122). In 1837 the church was described as 'a plain substantial building,… on the site of an abbey said to have been founded by St Canice, or, as some think by St Patrick, the former having been the first abbot: several of the early saints were interred here, and there are monuments to members of the families of Flower and Bridges, and one to Dr Chaloner Cobbe, an eminent divine' (Lewis 1837a, 629). By 1843 however, the primary site of worship in Finglas was moved to another site (Ball 1979b, 123). One of the individuals buried at St Canice's church is Eliza Wollstonecraft Bishop, who died March 1st, 1828. Her sister Mary was the wife of William Godwin, and their daughter Mary wrote the novel *Frankenstein* (Robinson 2005, 9).

Although Finglas is now firmly within the suburbs of the city of Dublin, for much of its history it was a rural location. Several troops of Henry II archers were encamped here in the twelfth century, when they reputedly cut down yew and ash trees in the graveyard whose planting had been attributed to St Canice himself (Ball 1979b, 84). Following the Anglo-Norman invasion, the settlement itself became largely English, being located well within the Pale of medieval Dublin. However, it certainly did not escape the ravages of the mid-seventeenth century with the rebellion of 1641 and the subsequent Confederate Wars.

However, it remained steadfastly Protestant in composition. On July 5th 1690, William of Orange made camp here, directly after his victory at the Battle of the Boyne (Ball 1979b, 104-105). With the Ascendency, Finglas came to be seen by the gentry of Dublin as a rural retreat and gained the reputation of a place for recreational break (Ball 1979b, 112). There was an attempt in 1769 to elevate Finglas to a similar status as that of contemporary continental resorts: a man named Patrick Joyce of Kilkenny, posing as a Turk named Dr Achmet, extolled the curative properties of St Patrick's Well in the village (Ball 1979b, 113). However, by the end of the eighteenth century Finglas had lost the status as a retreat for the gentry (Ball 1979b, 114).

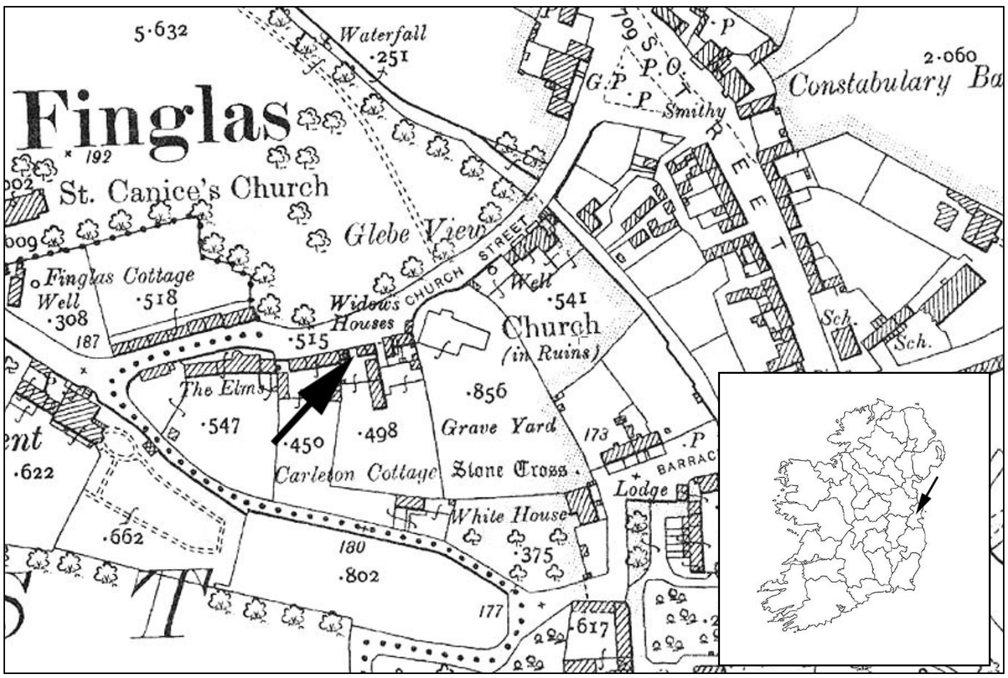


Figure 4.6.
St Canice's Church, Finglas (at centre of image labeled as 'Church (in ruins)'), late nineteenth century (2nd ed. 6"OS map (www.osi.ie), north to top), approximate location of excavated skeletons arrowed

As well as the church (**DU014-066009-**), three other RMPs are recorded for the site. These include a high cross (**DU014-066010-**), and two seventeenth century graveslabs (**DU014-066015-** and **DU014-066016-**) The NIAH has not yet published its data on Finglas.

4.4.4.1 Excavation

Excavations were carried at 4-8 Church Street near the centre of Finglas in Dublin in 2004 in advance of the development of the site as an apartment complex. The excavation was undertaken by John Kavanagh of National Archaeological Services Ltd (licence number

04E0900) (Kavanagh 2007). The site was located directly to the east of the medieval church of St Canice. A substantial ditch, sealed with a medieval ploughsoil was identified as the earliest activity, and was located at the southern end of the site, aligned east/west. This ditch may relate to the early monastic enclosure that is believed to have been located here. A burial, dating to the Viking period, was found close to St Canice's Church at the north end of the site. A large east/west ditch, over 4m deep and 7m wide, was uncovered crossing the centre of the site and was dated to the medieval period. This ditch may have been associated with the Archbishop's Manor, dating to the twelfth century, and the defensive earthworks known as King William's Ramparts. Evidence of domestic activity was uncovered to the north of the ditch. During the excavations, 22 burials were found alongside, and partially under, the cemetery wall to the east of the site. That wall had been rebuilt in the twentieth century. Finds associated with the burials indicated that they dated from the eighteenth/nineteenth centuries (ibid.).

4.4.4.2 Summary of Osteoarchaeological Analysis

All of the skeletons from Church St were examined in full by the writer prior to their inclusion in the present study. The results of that former study are presented here.

The remains of 13 individuals were available for analysis. There were six adults and seven juveniles. In the adult group, there were at least two females and three males. It was only possible to determine the age-at-death of two adults (a female and a male) and both were aged between 17 years and 25 years at the time of death. No infants were present, while the remaining juveniles were either aged between 1 and 6 years or were adolescents.

Dental remains were recovered from both adults and juveniles. Calculus, caries, abscesses, periodontal disease, and hypoplastic defects were present in the dentitions of the adult individuals, while both caries and calculus were identified in the juvenile remains.

There were few pathological lesions on the skeletal remains. Degenerative joint disease was present in two adults. Spondylolysis was present in the spine of a young female adult.

4.4.5 St John's Lane, Waterford City

St John's Lane in Waterford is the recorded site of a Religious Society of Friends burial ground. Members of the Religious Society of Friends are more commonly known as Quakers. They were founded in England in the seventeenth century, following dissatisfaction with the established Christian denominations. William Edmundson is known as the 'first Irish Friend'. An orphan, originally apprenticed as a carpenter in York in England, he served in the Cromwellian army between approximately 1647 and 1651. It was during that time that he first came into contact with Quakers and by 1653 he had fully embraced the belief system. He had moved to Ireland *circa* 1652, where he soon began actively organising the first Friends meetings (Miller et al. 2003, 244). However, meetings were not formally established across the country until 1667 (Vann and Eversley 1992, 15). Most of the Quakers in the south of Ireland originated from northern and southwest England, while Quakers in the north of Ireland principally came from the southwest of Scotland. All remained noticeably separate from the main Irish population (Vann and Eversley 1992, 39). By 1700 there were between 450 and 500 Quaker families in Ireland (Miller et al. 2003, 244). However, their numbers were never substantial. In the first decades of the nineteenth century it has been estimated that there were between 3,500 and 6,000 Quakers in Ireland (Vann and Eversley 1992, 39). The Quakers tended to concentrate in particular areas. In Ireland these included included Mountmellick, Cork, Dublin, Limerick, Wexford, Wicklow, Waterford, Moate, Lurgan, Newgarden, and Tipperary (Vann and Eversley 1992, 41). They were mainly artisans, shopkeepers, merchants, and professional people, and were noticeably 'better-off' than the main of the Irish population. '…The Irish Quakers, from all the available historical background material, would appear to be a population as sharply distinguished from the rest of Irish society as they could have been without living in a separate territory with a self-sufficient economy' (Vann and Eversley 1992, 51). Although the Quakers did largely form a skilled professional class, they remained noticeably distant from their peers in the Anglican Ascendency (Miller et al. 2003, 74).

Waterford was one of the areas in which a Quaker community formed, probably by 1655 (Johnson 2000, 70). Despite having comprised a relatively small proportion of the total population of Waterford, the contribution of the Quakers to the economic development of the city (as elsewhere) is remarkable (Noonan et al. 2006, 5). In Waterford, the Quakers were particularly involved in glass manufacturing, ironworks, brewing, biscuit making, ship building, and the cotton industry (Johnson 2000, 77). The excavation at the site on the northeast side of John's Lane in the city was at a known Quaker cemetery. This was in use from 1689 to 1764, when a new burial ground was established just off Cross Lane/Parliament Street (see **Figure 4.7**). The John's Lane site is estimated to contain approximately 200 individuals (Johnson 2000; Johnson 2004). A north/south orientated burial recently recovered during the excavations at the site of St Peter's Church in Waterford, has been postulated as possibly being that of a Quaker dating to the period between when the Quakers first appeared in Waterford in the mid-seventeenth century, to when their first burial ground was established in 1689, that is, the site that was excavated in 2004 (Fewer 1998).

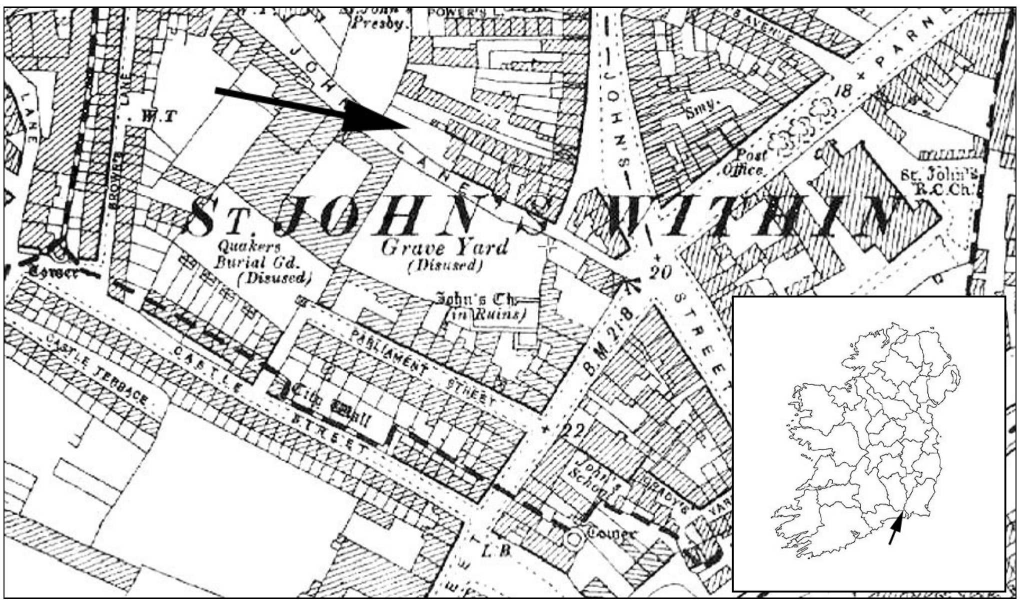


Figure 4.7.
John's Lane Quaker burial ground, Waterford, arrowed, late nineteenth century (2nd ed. 6"OS map (www.osi.ie), north to top), second Quaker burial ground to southwest

This burial ground is recorded as RMP **WA009-005123-**.

4.4.5.1 Excavation

The brownfield site was excavated by Daniel Noonan of Daniel Noonan Archaeological Consultancy in (licence number 04E1701), in advance of the construction of a development comprising a mixture of apartments and retail units, and associated site works. The excavation focused on two service trenches, which were scheduled to cut through the known location of the Quaker burial ground (Noonan et al. 2006, 2). Twenty one burials were excavated. Some of the skeletal remains were stained green through contact with copper alloy. It is possible that many of the stains may be indicative of shroud pins. All of the burials were orientated west/east, and burial was in simple coffins (Noonan et al. 2006).

4.4.5.2 Summary of Osteoarchaeological Analysis

A standard osteoarchaeological report (Lynch 2006) was completed on these individuals before their inclusion in the present study. The results of that former study are presented here.

Twenty-one inhumations were excavated from John's Lane. There were 14 adults and seven juveniles. Ten of the adults were females and four were males. It was only possible to determine the age-at-death of half of the adults. In the juvenile group, six of the seven were aged between 1 year and 6 years at the time of death.

Dental remains were recovered from four adults and four juveniles. Instances of calculus, caries lesions, dental abscesses, enamel hypoplastic defects, and periodontal disease were all evident.

A small number of skeletal pathological lesions were present. Joint disease was the most prevalent and was present in six out of the 14 adults. In general the lesions were relatively minor. However serious lesions linked to a degenerative disease were observed in the ankle bones of one individual. These lesions are likely to have been caused by one of the seronegative spondyloarthropathies. Just two examples of non-specific infection were present. A single adult had pathological lesions indicative of a metabolic condition, while a minor congenital defect was present in one of the vertebra of another adult (Lynch 2006, 22)

4.5 Urban Cemetery

This cemetery sample was larger in size than all of the others discussed above. It represents a mixture of individuals, comprising both urban natives and immigrants from rural areas, as well as wealthy and poor individuals.

4.5.1 St Anne's Graveyard, Shandon, Cork City

St Anne's Church (Church of Ireland) (see **Figure 4.8**) in Shandon is one of the most iconic architectural features of Cork city. With its elevated location on the north side of the city, its distinctive colours of old red sandstone and white limestone, and the famous Shandon Bells, the church forms an important part of the identity of Corkonians. However, it is only the most recent of a long lineage of churches in the vicinity. Certainly there was a church on the present site in the medieval period. Following the destruction of that church (St Mary's) in the siege of Cork in 1690, the site of the church was moved to a new area at the foot of Shandon, just to the north of the gate and bridge into the city. The present church of St Anne's was constructed in 1722 on the old site of St Mary's, as a chapel of ease to St Mary's at the foot of Shandon (NIAH 2013a), (although Lewis dates the construction to 1772 (Lewis 1837a, 423)). St Mary's fell into disuse and the site was cleared in 1930 and St Anne's became the main centre of devotion for the Church of Ireland congregation (Bradley and Halpin 1993, 34).

Shandon itself is located to the north of the site of the walled medieval city of Cork. It was linked to the island city by a bridge, the North Gate bridge, a version of which still exists today. In the medieval period Shandon was the property of the Lords of Shandon, who included the de Barry's, the de Predergast's, and the de Rochford's (Bradley and Halpin 1993, 35). Its location outside the walled city, and the presence of Shandon castle, made the area especially vulnerable to attacks by the native Irish. Records show that the suburbs of Cork were destroyed sporadically in the fourteenth and fifteenth centuries, while the church of St Anne's was demolished during the Williamite siege of Cork in 1690 (Bradley and Halpin 1993, 34-36).

Shandon had begun to develop its own trade in the thirteenth century, which was greatly resented by the merchants of the city. However, the prosperity was short-lived, as a combination of economic decline and attacks from native Irish ensured the fragility of any form of development in Shandon (Bradley and Halpin 1993, 35-36). Trade particularly concentrated in the walled area of the city. Indeed trading was the key factor in the development of Cork in the post-medieval period, with industrial output being considerably less important (Murphy 1980, 28; O'Brien 1993, 708). By the late eighteenth century Cork was becoming a vital cog in the economic makeup of the British Empire (Fahy 1993, 793-

794). Of particular importance was the export of agricultural produce. The butter trade, which grew exponentially in the nineteenth century, became synonymous with the Shandon area with the development of the Butter Exchange. Tanning and textile manufacturing were also important industries, and brewing and distilling became increasingly important. However, much of the trading business was essentially a false economy. It particularly developed in association with Britain's military and naval exploits as a supply chain in the eighteenth and nineteenth century. Following the end of the Napoleonic Wars there was an economic depression, which significantly impacted on Ireland, with Cork suffering in particular on account of its reliance on trade. In addition, the removal of trade tariffs on British imports in 1824 ensured the markets were flooded with cheap imports and certain aspects of agriculture and trade suffered significantly. The levels of poverty and destitution increased significantly in Cork, as in the rest of the country, as the nineteenth century progressed (Fahy 1993, 794).

Post-medieval Cork city was, like others, quite diverse. While many urban centres in Ireland acted as a hub for those loyal to England, and later to Britain, in reality the populations were very mixed, and both native Irish, Old English (from the Anglo-Norman invasion), and New English (from the Plantation era) coexisted within the urban environment. By the post-medieval period, the native Irish primarily comprised Roman Catholics, while most of the Old English had converted to the Protestantism of the New English. Despite the best attempts in the Plantation era, the native Irish remained the largest component in the country's population. In Cork at the end of the eighteenth century, just 20% of the city's population of 54,000 individuals were Protestant (Lane 2010, 28). The suburbs of Cork only developed very slowly, and were not significant until well into the eighteenth century (Fahy 1993; O'Brien 1993). The population of Cork, rich and poor alike, preferred to dwell within the area of the old city on the islands. 'Thus, within the confines of the city centre all social classes shared the limited space available: merchants rubbed shoulders with artisans, artisans with labourers, Protestants with Catholics; and all these groups were directly confronted with the vast army of destitutes who, impervious to the fading employment opportunities in the nineteenth century, squatted in central Cork' (O'Brien 2002, 336). The majority comprised artisans and labourers, both Catholic and Protestant (Lane 2010, 28). By the 1820s, 35% of merchants in Cork were Catholic (Fahy 1993, 794). Cork was particularly notorious for the density of habitation, and few areas were exclusive to particular classes (O'Brien 2002, 336). However, there were of course different conditions in different parts of the city, primarily due to the numbers of people. For example, in 1841 there was a density of just 18 people per acre in St Anne's parish in Shandon, compared with a density of 219 people per acre in St Peter's parish (O'Brien 1993, 707; O'Brien 2002, 335).

Poverty became a real and substantial problem in the city in the nineteenth century. It was concentrated in particular in the old medieval area of the city and in the areas around Shandon Street and Bandon Street (Fahy 1993, 794-795). The city acted as a magnet for those living in distress in the rural hinterland, which only exacerbated the problem. The population of Cork almost doubled in less than 100 years, from an estimated 41,000 inhabitants in 1750 to 80,000 in 1821 (O'Brien 2002, 328). In addition, under the Law of Settlement, paupers of Irish origin found in England were shipped back to Ireland. Inevitably, they were literally left on the quayside to fend for themselves, and they rarely left the city to return to any rural origin (Lonergan 1992, 94; Murphy 1980, 27). For example, in September 1840 150 paupers from London were landed in Cork, despite the fact that 120 of these were not originally from Cork (O'Mahony 2005a, 78). This was before the exodus of Irish during the Great Famine. The level of destitution rose substantially. In 1829 Cork had the highest unemployment levels of all contemporary Irish towns, with 80% of men out of work (O'Brien 2002, 334). In 1832 a considerable 7% of the population of the city was destitute (Murphy 1980, 28). On the eve of the famine, an almost 73% of Cork families lived in slum accommodation (Murphy 1980, 29). Clearances of these slum only began in earnest in the 1870s under the Crosses Act, and concerns about the visual improvement of the city are likely to have been as much, or more, of a motivational factor in their demolition as was basic concern for the conditions of the poor (O'Brien 1993, 707; Murphy 1980, 30).

Although undoubtedly the excavated graveyard was associated with St Anne's Church itself and its parish, the cemetery was also associated with the North Infirmary Hospital, now the Maldron Hotel, which was located directly to the east of the graveyard. The construction of the hospital certainly resulted in the truncation of older burials on the site (Margaret McCarthy, pers. comm.). The Green Coat Hospital, a small infirmary, had existed on the site in 1719, but this offered an out-patient service only (Cummins 1957). The foundation stone for the North Infirmary was laid in that year, although it did not admit any patients until 1744 (Kelly 1999, 27). The hospital, the first general hospital to be built in Cork, had the then exceptional ratio of having 11 physicians to five surgeons (Farmar 2004, 50; O'Sullivan 2007, 82). This is because, in contrast to its equivalent, the Dublin Infirmary, where the emphasis was on the treating of physical injury, the emphasis in the North Infirmary in Cork was on the prevention of the spreading of contagion (Kelly 1999, 27). Most of the surgical teaching facilities in Cork were concentrated in the South Infirmary hospital. It was not until 1836 that was the first students in surgery were taken in by the North Infirmary (Cummins 1957, 8). Evidence of post-mortems and dissections were identified in the excavated assemblage (see **Section 4.5.1.2**). Certainly in the early stages, the hospital was not large. In 1744 it had just 20 beds (Cummins 1957, 4). The Medical Reports from 1750 and 1801 recorded 75 and 88 deaths in the hospital respectively. The hospital was taken over in 1832 as a Cholera Hospital, and again in 1847 as a Fever Hospital (Cummins 1957, 8). The original building was replaced in 1836 (Cummins 1957). The hospital continued to function until 1988, when it was closed down (O'Sullivan 2007, 82). The building was later redeveloped as the Shandon Court Hotel (which resulted in the excavation of part of the adjacent cemetery), and is presently under the ownership of the Maldron hotel group.

The location of the graveyard immediately adjacent to the site of the former North Infirmary Hospital and the finding of skeletal evidence of autopsies and dissections (see **Section 4.5.1.2**), indicates that at least some of the recovered burials relate to the hospital. While it is evident that the hospital was attended by ill individuals, particularly in times of stress such as when it was overtaken as a cholera hospital in the 1830s and a fever hospital in the 1840s, most of the destitute poor of the city would have gone into the city workhouse (Lynch 2004, 77). Therefore, while there are undoubtedly poor people buried in St Anne's cemetery, most are unlikely to have been from the huge numbers of paupers and destitute of the city in the nineteenth century. In any case, burial in a cemetery such as this would have required at least some money. In addition, breast plates were recovered from a number of the graves (Margaret McCarthy, pers. comm.), indicating that at least some people had the wealth to afford more lavish coffins.

This graveyard is recorded as RMP **CO074-033002-** and is also listed on the National Inventory of Architectural Heritage (Registration Number: 20512028). St Anne's Church is also an RMP (**CO074-033003-**) and on the NIAH record (Registration Number: 20512027), as is the former North Infirmary Hospital, now the Maldron Hotel is on the NIAH (Registration Number: 20512037), and is recorded as the site of a leper hospital on the RMP (**CO074-033004-**).

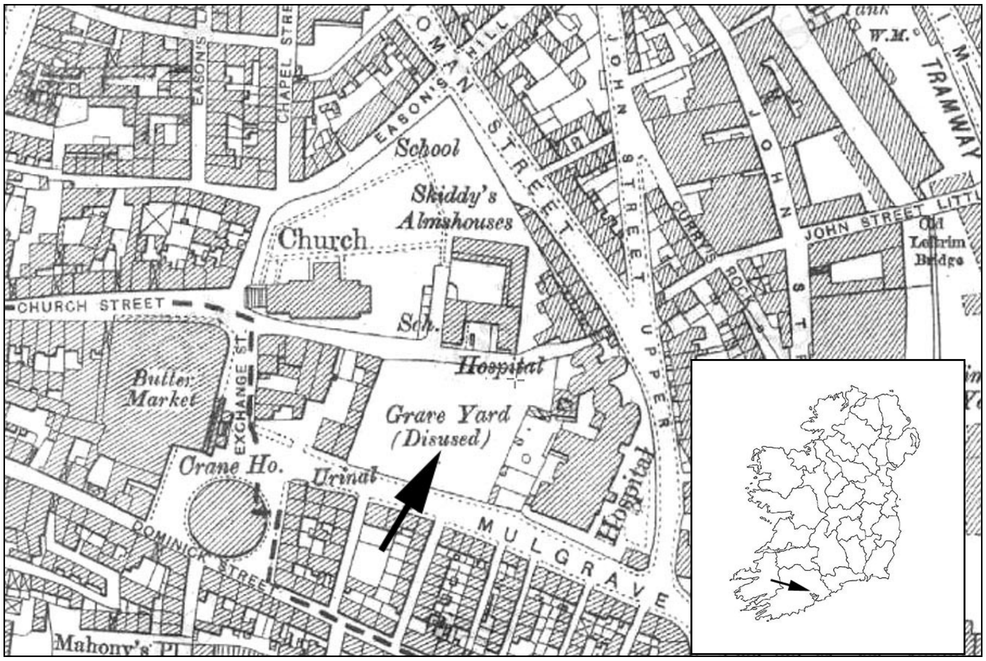


Figure 4.8.
St Anne's Graveyard, Cork, arrowed, late nineteenth century
(2nd ed. 6"OS map (www.osi.ie), north to top),
St Anne's Church is located directly to the northeast, Skiddy's Almshouses were to the north, and the North Infirmary Hospital was located to the east of the graveyard

4.5.1.1 Excavation

Excavations at St Anne's Graveyard were undertaken in 2002, in advance of the redevelopment of the former North Infirmary Hospital as a hotel. The excavations were undertaken by Margaret McCarthy, then of the Archaeological Services Unit attached to University College Cork (licence number 01E0529). In total, 267 burials were excavated, and large quantities of disarticulated human remains were recovered. Preservation levels varied across the site, with some skeletons truncated and/or eroded and fragmented, while others were in an excellent state of preservation. The burials date primarily to the nineteenth century (Margaret McCarthy, pers. comm.). Breast plates were recovered with a number of burials, as well as other coffin furnishings.

4.5.1.2 Summary of Osteoarchaeological Analysis

A standard osteoarchaeological report (Lynch 2004) was completed on these individuals before their inclusion in the present study. The results of that former study are presented here.

A total of 267 skeletons were excavated from St Anne's graveyard. There were 225 adults and 42 juveniles. There were slightly more male adults (101 individuals) than female adults (86 individuals). Due to poor preservation rates, it was only possible to determine the age-at-death of just under 47% of the adults. Just over half of those where aged between 25 years and 45 years at the time of death, with the remainder were relatively evenly distributed between young and old adults. Just a single infant was present in the juvenile sample, with the other 41 juveniles distributed quite evenly between the ages of 1 year and 16 years.

Stature analysis suggested that the females were shorter than many of their contemporaries, while the males were approximately comparable.

The adult dentitions revealed a high prevalence of all dental diseases and conditions which, unsurprisingly, appeared to increase in severity with age. There were high prevalences of calculus, caries, ante-mortem tooth loss, abscesses, and periodontal disease. Attrition only became significant through ante-mortem loss of teeth and subsequent malocclusion. Assessment of juvenile dentitions indicated that the dental problems began early in life. Evidence of dental enamel hypoplastic defects was identified in both the adult and juvenile populations, and it appeared that the adults who were subject to physiological stresses in childhood had a lower life expectancy. The juveniles had evidence of physiological stresses occurring earlier in life than the identified adult period, which may indicate physiological stresses that lead to a decrease in life expectancy. Numerous examples of pipe-smoking individuals were identified in the adults, and males individually were predominantly affected. Two adolescents also had the lesions. A number of individuals, primarily adults but including a small number of juveniles, had chipped and/or grooved enamel probably associated with occupational activities.

Degenerative joint disease was common in the adult individuals. All joints were affected, though in differing degrees of prevalence. Some DJD was identified as occurring secondary to instances of trauma in particular, as well as other pathological conditions. Spinal joint disease was particularly prevalent and revealed a number of biases. Overall spinal DJD tended to concentrate in the cervical vertebrae of the females, while Schmorl's nodes were especially dominant in the male adults. Osteoarthritis was only identified in the extra-spinal joints of the females in old age while it was identified in the male middle adult group. The converse was true for spinal DJD. Degenerative joint disease was only identified in the spines of the adolescent juveniles and exclusively took the form of Schmorl's nodes. Cases of possible ankylosing spondylitis and DISH were tentatively identified, as well as a case of juvenile kyphosis.

Evidence of non-specific infection was quite prevalent, with over one-third of adults and almost 60% of juveniles being affected. Considerably higher numbers of adult males were affected than females, with males twice as likely to have periosteal lesions. The tibiae and ribs were the bones most frequently involved. Deposits of fibre bone were the most common manifestation. Two cases of osteomyelitis were also identified. In addition, the lesions were typically either bilateral and/or were present on both upper and lower limb bones. The multiplicity of many of the lesions point to systemic infection. A number of instances of more specific lesions were present. These primarily include sinustitis and tuberculosis, and inflammations related to dental abscesses. Two possible cases of poliomyelitis were identified. It is surmised that some of the endocranial bone lesions may represent cases of tuberculous meningitis.

A number of metabolic disorders were identified including iron deficiency, Vitamin C and D deficiencies, and internal frontal hyperostosis. Cribra orbitalia was more prevalent in the female adults than in the male adults, and the total figures indicate a decrease in frequency from young adults to old adults. Porotic hyperostosis was also identified, and revealed a higher male prevalence. A single case of Vitamin C deficiency or scurvy was identified, but cases of Vitamin D deficiency or rickets were relatively common. The latter was particularly confirmed by the bowing of limb bones. A number of cases of internal frontal hyperostosis were also present, and followed the expected pattern of affecting older adults.

Trauma primarily took the form of healed fractures, although some instances of dislocations and subluxations were also present. The incidence of trauma increased from young adults to old adults, and males were more typically affected than females. Most injuries were healed or healing at the time of death. Two cases of cranial fractures were unhealed and these individuals had been the subjects of autopsies/dissections after death. A disarticulated skull fragment also had an unhealed penetrating injury. A number of fractures were particularly concentrated in the right hand bones, which is suggestive of handedness.

The congenital abnormalities primarily consisted of minor defects in the development of the spine, with some minor anomalies in the hand bones. However, three rare defects were also present. These were the congenital absence of the medial epicondyle of the humerus, agenesis of the ulna, and congenital radio-ulnar synostosis. The first two developmental defects in particular would have resulted in a reduction in the functions of the arms affected.

The evidence of neoplastic disease was minimal in this population, consisting only of a single benign button osteoma on the cranial vault of one individual.

There were numerous examples of post-mortem surgical procedures being carried out. The crania of seven adults (and one other disarticulated skull) had the skull-caps sawn off to expose the brain cavity in an autopsy/dissection procedure. At least two of these had scalpel cuts for the removal of the scalp. Two of these individuals had suffered from cranial fractures around the time of death. Another adult and one child had had autopsies/dissections performed on their torsos, with different implements used in both cases. The adult also had internal cuts to the ribs. In addition, two disarticulated femorae from Context 94 (mass of disarticulated bone) appear to have been dissected, probably for use as teaching aids and/or for samples.

Finally, anomalies were present on the skeletons of five other individuals. Popliteal aneurysms were present in two individuals. Small bony nodules were present on the endocranial surface of one individual. In addition, the lacrimal fossa in the orbit of another individual was abnormally deep indicating an enlarged lacrimal gland. It was not possible to determine aetiology in either case. In addition, ossified plaques of pleura recovered with some individuals may have had their origin either in trauma or infection (Lynch 2004, 68-71).

The following three chapters will present the analysis of the evidence of health in terms of the selected skeletal markers in the three groups in the present study.

CHAPTER 5:
Stature and Femoral Length

5.1 Introduction

In Western history, body-size has frequently been associated with a healthy disposition (Deaton and Arora 2009). This has traditionally been intimately linked with food consumption. Many people today would be familiar with the image of the rosy-cheeked, red-nosed, bloated aristocrat and his wife, as frequently depicted in the British nineteenth century Punch cartoons. It was perceived that the wealth of aristocrats allowed them to eat the best of foods, in as much quantity as desired. Thus, a large body size was an indication of wealth. The linking of stature with health follows similar logic: if a person consumes good-quality food they will be taller. A diminutive stature was seen, at least, as an indication of poverty (Floud and Wachter 1982a). In some instances a short stature may literally have meant a short life. In a study of Trinidad slave statures, it was found that in every age group the shorter individuals were more likely to die (Fogel et al. 1983, 471). It has been estimated that an additional one centimetre corresponds to 1.2 years of additional life (Baten and Komlos 1998; quoted in Baten 2009)

However, the relationship of food intake with growth and final stature is considerably more complex. 'Nutritional status is a … net rather than a gross measure of nutrition: it measures not what the human body takes in … but what the body makes of those nutrients with other pressures and requirements' (Floud 1994, 11). Thus, nutritional status is open to significant influence by a wide variety of factors: from literacy levels to geographical location to occupation to sex, to name but a few (see **Section 5.3**). The standard of living of those in the 'developed world' has improved through the centuries, and particularly in the last two hundred years, and there has been a corresponding increase in both height and life expectancy (Cole 2003; Garcia and Quintana-Domeque 2007; Komlos 2006; Riley 2000). In a Canadian study, Hoppa and Garlie (1998) found that children in nineteenth century Toronto were about 10cm shorter than their modern-day counterparts. 'Poor growth and short stature are trade marks of deprivation' (Cole 2003, 166). However, the improvements in the modern era were not steady and they were not enjoyed by all sectors of society.

The study of growth and stature, and the effects of poor nutrition on the same, has a clear scientific link (Fogel et al. 1983). While acknowledging the importance of genetic inheritance, it is the symbiotic relationship between nutrition and other influencing factors that ultimately determine the stature of an individual. Indeed, the assessment of growth patterns, auxology, is extensively used in modern studies of economic history and to assess the standards of living of a range of societies both past and present (Brennan et al. 2004; Steckel 1995). This chapter will examine the history of the study of stature (**Section 5.2**), the patterns of human growth (**Section 5.3**), and particularly the non-genetic influences on growth and final stature (**Section 5.4**). It will look at examples of studies of Irish stature and specifically how it had been surmised that the Irish formed a relatively unique group in terms of the general statures of the eighteenth and nineteenth centuries in Western Europe (**Section 5.5**). The bioarchaeological expectations of the present study are presented (**Section 5.6**). The methodology has already been detailed in **Section 4.2.2**. The results of the assessment of the statures of the skeletal populations utilised in the present study are presented in **Section 5.7**, while the discussion of the results is provided in **Section 5.8**. It will specifically address how the current skeletal data tallies with the contemporary records of height in the post-medieval period, with the work of those who study the relationship between health and growth, and with relevant archaeological skeletal populations, both in Ireland and further afield.

5.2 Development of Stature Studies

The seminal work of Bogin in *Patterns of Human Growth* (1988) provides an excellent summation of the development of the study of human growth and the following is largely based on his work.

The earliest recognised longitudinal study of growth occurred in the eighteenth century. Count Philibert de Montbeillard of France, measured the height of his son every six months from the time of his birth in 1759, until the boy's eighteenth birthday. The measurements were published by Buffonin 1777 in a *Supplement* to *Histoire Naturelle*. For the first time it was established that, just like the plant world, there were seasonal variations to human growth: the boy grew more in the summer than in the winter months. Another important early study, which took place in the same century, was on the students of Carlschule in Germany, a school founded by the Duke of Württenburg. The school included those from the ranks of the nobility and the bourgeoisie. The study found that, during the growing years, the nobility were taller, but by 21 years of age both groups were the same in height. This was the first real indication that socioeconomic status may influence growth. It also established the concept of 'catch-up' growth.

In 1835 Lambert Adolphe Quetelet published the first statistically complete study of growth and weight in children. From that time onwards detailed statistical methods were utilised and developed, in order to come to a greater understanding of the processes of human growth. This was particularly pioneered by Luigi Pagliani in Europe and Henry P. Bowditch in the United States. The former noted differences in growth rates between the rich and poor, while the latter favoured the influence of environmental factors over genetics for the differences in height that he recorded. The linking of growth and environmental influences had become more acceptable from the early nineteenth century (Steckel 1995). René Villermé's study in 1829, of the heights of soldiers in France and Holland, concluded that poverty was more important than climate on influencing the rate of growth (ibid.), while in 1833, the British parliament brought in legislation using stature as a criterion in evaluating the minimum standards of health for child labour. This was based on Edwin Chadwick's seminal study 'Report of the Employment of Children in Factories' (Steckel 1995, 1907; Bogin 1988, 12).

Despite this undeniable link of growth with environmental influences, and particularly with living conditions, racial arguments ultimately entered the fray. Franz Boas undertook a major study on migrants to prove the very strong effect of environmental factors on growth. *Changes in Bodily Form of Descendants of Immigrants* was published in 1912. The ultimate conclusion was that children of short migrants experienced growth gain on migration to the United States as a result of the changed improvement in living conditions (Bogin 1988, 11ff.). Such works were important considerations in the formation of immigration policy in the United States. Ultimately, in the 1920s the proponents of hereditary stature won out against the arguments of those such as Boas, and very specific migration quotas (or limits) were placed on some southern and eastern Mediterranean countries.

As the twentieth century progressed the intensity of study of human growth and development evolved considerably, particularly in the latter half of the century. A study by James M. Tanner in the early 1980s (Tanner 1981) highlighted the range of work on human growth that had been undertaken in the US until that time. In reality, the study as an actual discipline was in its relative infancy (Engerman 2004). Tanner approached human growth from a medical point of view and, while his work is invaluable to the understanding of human growth, it was perhaps the studies undertaken by many of those he influenced that broaden our understanding of human growth in terms of an archaeological context. Economic historians Robert W. Fogel and Richard H. Steckel in the US and Roderick Floud in Britain, and British demographer Kenneth Wachter, amongst others, have undertaken a broad range of studies in both in the US and the UK, and further afield, on the relationship between the development of the human form and nutrition in terms of the economic realities of specific groups with known histories (Floud 1983; Floud 1994; Floud et al. 2011; Floud and Wachter 1982b; Floud et al. 1990; Fogel et al. 1983; Margo and Steckel 1982; Nicholas and Steckel 1991; Nicholas and Steckel 1997; Sandberg and Steckel 1997; Steckel 1986; Steckel 1994; Steckel 1995; Steckel 2004). As the twenty-first century continues the studies have developed along two themes: examining growth as a means of biological adaptation, and growth as an index of health (Schnell et al. 2009). Both branches of study have implications for the present study and are examined in more detail in **Section 5.4**.

5.3 Patterns of Human Growth

Human beings follow a set pattern of growth from the moment for conception (Bogin 1988). Maternal health and adequate early infant care is crucial to the development of the young child (Brennan et al. 2004; Neumann and Harrison 1994). Following birth the development of a human is at its greatest during infancy, which sees a great increase in height and velocity of growth. This falls sharply up to the age of 3 years and falls more slowly up to adolescence. The rate of growth increases again in this period, to about half that experienced in infancy. Growth ceases at maturity. The adolescent growth spurt is a well-recognised phenomenon, with clear differences between the sexes. It starts 2 years earlier in females than in males, and is of less magnitude. 'The pattern reflects the interaction of genetic, environmental, and socioeconomic factors ' (Fogel et al. 1983, 448).

It is these interactions which are of most interest to those studying human growth and stature. Multitudes of studies have been undertaken, both on historical records of stature (for example from army records) and on modern populations, to assess the cause and effect factors involved. Studies have indicated that the greatest variation in long bone growth occurs between the ages of birth and four years (Pinhasi 2008, 374). Interestingly, this is also the period of the highest rates of mortality in children (Rousham and Humphrey 2002). After this time, those who may have been small in childhood can essentially 'catch-up' with their peers. This 'catch-up' growth is dependant however, on an individual receiving sufficient dietary intake over a significant period of time, and especially at the right period of time (Golden 1994). If the conditions are inadequate for catch-up then the growing period may be extended for many years. As an example of the sensitivity of human development to external influences, is the timing of menarche, the first menstrual bleed in females. It is intimately linked with growth (Tsuzaki et al. 1989). Menarche may be delayed in populations where normal growth has been comprised, typically as a result of inadequate nutrition (Eaton and Eaton 1999). In contrast, in an extensive study of the growth patterns of 22 societies across the world, it has been found that those with high mortality developed faster (Walker et al. 2006). In modern, well-nourished individuals today in the Western world, growth ceases at approximately 20 years (Floud 1994, 22). In other societies, if the period of stress is very long or very severe then full normal stature may never be attained (Steckel 1995).

Patterns of growth are ultimately highly influenced by external factors. The adult remains of negro slaves in the US have been noted as being tall and well-developed (Margo and Steckel 1982), in comparison to what one may expect, given the living conditions of those individuals. In a comprehensive study of slave statures in the United States, Richard Steckel found that, despite very significant serious health issues from birth, individuals experienced a considerable degree of 'catch-up' growth in adolescence (Steckel 1994). It appears that, as the slaves reached their full productivity age, they were provided with significant additional nutrition to counteract the considerable strains imposed on them by the work and living conditions (ibid). This then allowed the enslaved to reach significant statures. Ultimately perhaps, what is pertinent here is the historical data. The growth and development of slaves was ultimately controlled by their masters. The social and economic environment encouraged the slave industry in North America. The development of the body of the slave was ultimately completely beyond his/her control. From severe maltreatment as children to well-nourished adults of 'productive age', the growth patterns of these individuals could never be understood without the historical context.

Despite the obvious importance of nutrition to the development of the human body, it is perhaps more important to think, overall, of the ability of a group or population to adapt to circumstances, and how that influences the rate of growth. 'Genetic traits', such as shortness of stature, may be changed within a generation, indicating that environmental stressors are the primary controllers of growth (Tanner et al. 1982). The diminutive body size and stature of some tropical populations have been attributed to necessary genetic adaptations to the environment (Stini 1986). Much of the pattern of growth in children may be seen as a means of adaptation (Goodman et al. 1984, 18; Stini 1982). It has been surmised that environmental factors are more influential on childhood growth, while adolescent growth is more influenced by genetics (Bogin 1988, 115). This would account for the somewhat extraordinary catch-up growth mentioned above in relation to Afro-American slaves. Indeed, it has been surmised that short stature in juvenile remains may actually indicate less physiological stress, while an increase in stature may suggest more stress (Byers 1994; Wood et al. 1992). However, in a study of stature and the Great Chinese Famine of 1959-1961, it has been found that increased height in children was an advantage when it came to the likelihood of survival in periods of such stress, and individuals who were less than five years of age at the time of the famine had a final stature that was 1/2cm shorter than average (Gørgens et al. 2012).

Differences in the growth rates of females and males have been noted also. The variations in the growth rates in the adolescent period have been referred to above (this **Section**). However, there are also differences in the susceptibility of females and males under in terms of growth patterns when under stress. Typically the growing male is more susceptible to stress than the growing female (Eveleth and Tanner 1990; Goodman et al. 1984, 20). The preliminary results from the European module of the Global History of Health Project, representing just under 10,100 skeletons, confirm this (www.global.sbs.ohio-state.edu/FINALAAPAGHHP.pdf). From the medieval period onwards, as overall health in Europe was declining, male statures declined faster than female statures (ibid.). However, conversely, a study of the Great Chinese Famine of 1959-1961 found that females were physically more seriously affected than males (in terms of growth). The famine stunted the growth of children that were exposed in early childhood, but the study also found that taller children were more likely to survive (Gørgens et al. 2012).

While a tall stature may traditionally have been seen as an indication of health, there are studies that reveal the complexity of the issues involved. As noted earlier, stunted growth has been interpreted as being an adaptive response to negative stresses (Stini 1982). A study in Yucatán in Mexico found that stunted stature may have been an actual positive adaptation to undernutrition, with such individuals over the age of two years apparently able to cope better with periods of stress (Balam and Gurri 1994). Thus the taller child/adult may actually have been at a disadvantage in terms of the level of immunity to various stresses. Wolański and Siniarska (2001) had similar findings in their study of Polish statures. A key conclusion of their work was that stature varied most between close populations and least between distant populations. The fundamental influencing factor was social strata rather than genetic and/or ethnic groups (ibid., 306). Two decades earlier, Floud and Wachter (1982a) looked at records of statures taken by the Marine Society, a philanthropic foundation assisting poor boys in London in the eighteenth and nineteenth centuries. The short statures of the poor, as indicated by nineteenth century observers and confirmed by the Society's records, was intimately linked with the environmental conditions in which the children grew up, including malnutrition. However, the stunted growth may be interpreted as a positive adaptation, a measure by which the human body adapts and survives in extreme conditions or circumstances. In contrast Komlos (1986) found no difference in height between the Hapsburg aristocratic youth and the boys in an Austrian orphanage, in his study of children's height in eighteenth and nineteenth century Europe.

As mentioned earlier, cyclical patterns of human growth have been clearly identified. There are, of course, the growth patterns associated with the development of humans in general, as well variations associated with the seasons, not only in relation to humans growing more in the summer months, but also the variability in the availability of seasonal foodstuffs. However, the human race in general has experienced numerous cycles in terms of the development of stature in the species in recent centuries. Studies have clearly indicated that these cycles have been intensely influenced by social, political, and economic developments. There has been a general increase in height and weight in developed countries since the mid-nineteenth century (Cole 2003), and there is no doubt that people are taller today than in the past (Komlos 2006). However, it was not, as may be believed, a steady increase. In northern Europe, the average stature fell over 6cm from between *circa* 1450 and 1750 (Steckel 2004). The decline was greater than any noted associated with the

Industrial Revolution and the statures of the medieval period were not reached again until the twentieth century (ibid.). The average stature grew during the period of the Industrial Revolution and then fell back in the middle of the nineteenth century. It reached its previous peak again by 1914, grew slowly between the two World Wars, and then accelerated after 1945 (Floud et al. 1990, 325). The reasons for the decline were manifold. They include climate deterioration, growing inequality, urbanisation, fluctuations on population size, globalisation, and conflicts (Steckel 2004).

It appears that the traumatic events of the Napoleonic wars at the start of the nineteenth century, involving not only conflicts but with filtering socioeconomic effects, had a significant impact on the health of various populations both in terms of negativity and positivity. It is possible that the sheer levels of data available (for example, military, naval, convict, and prisoner records) have over-influenced our perception of this period. It cannot be doubted that, for example, the Black Death epidemics in Europe in the medieval period, had both instant and long term effects on the growth patterns of humans, but the effects are extraordinarily difficult to measure given the contextual foundation. Certainly the late eighteenth onwards provides us with some of the most comprehensive and accessible data in terms of human growth and economic circumstances. After the end of the wars in 1815, the average statures of the poor in London increased by as much as 12cm (Komlos 1986). Ironically afterwards, the decline in stature between 1820 and 1850 has been intimately linked with the growth in the economy in the same period, a factor that will be examined in **Section 5.4**.

5.4 Factors Affecting Human Growth

Figure 5.1 examines the complex interactions involved in the determination of the final stature of an individual, the consequences such factors may have on an individual, and the sources that may be utilised in the study of stature.

In terms of archaeological contexts it is rare that many, if any, of the determinants identified in **Figure 5.1** can ever be assessed with accuracy. This is crucially where the post-medieval and early-modern contexts of some sites, such as those in the present study, come into the fore. The abundant documentary and/or historical data, which may be associated with these sites, can allow for the contextualisation of the growth patterns apparent in the skeletal group. The 'functional consequences' of a diminished or increased stature may have significant repercussions on the original determinants. An increased height generally appears to be more beneficial over a decreased height. As an individual reaches full maturity, it may be surmised that these repercussions are minimalised, as the growth of an individual can no longer be influenced. However, in reality, the cycle can continue into the next generation, where the offspring of those of stunted growth will be burdened with the history of the parents' past.

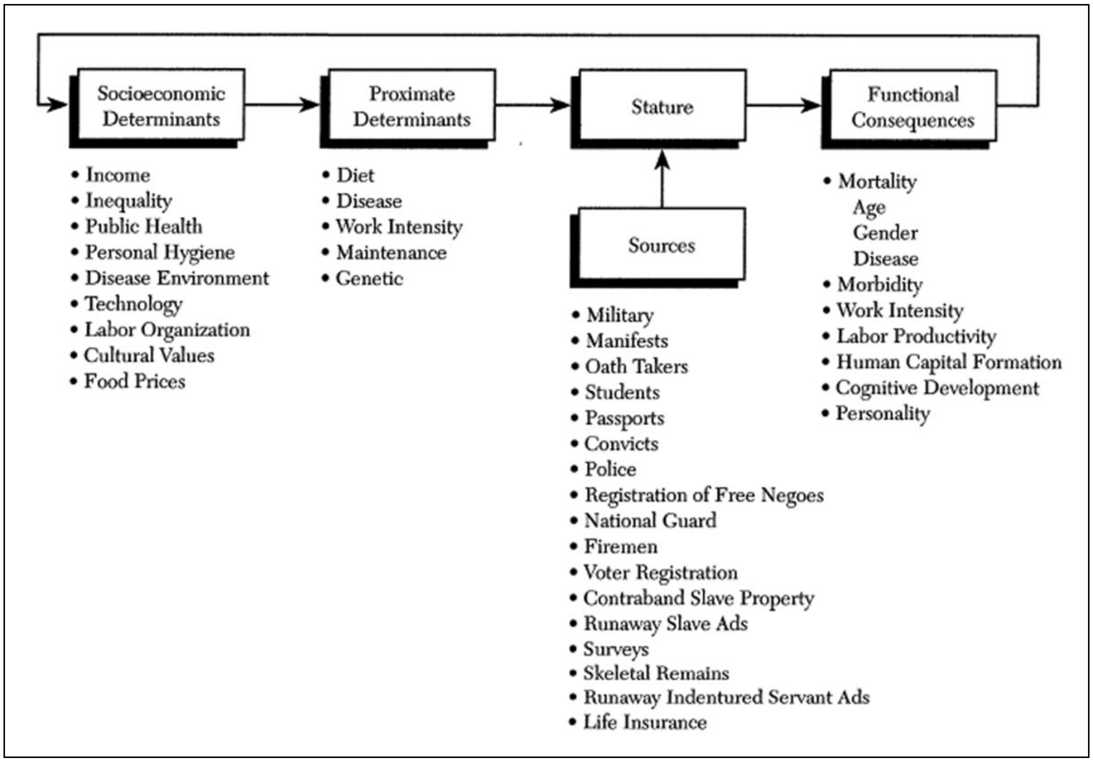


Figure 5.1.
Relationships involving stature (Steckel 1995, 1908, fig. 1)

Ultimately, nutrition levels may be determined by a considerable number of factors. Place of birth, legitimacy at birth, occupation, and wealth have been found to be influencing factors (Lantzsch and Schuster 2009). Similarly, education has been found to be an important influencing factor (Salvatore 2004; Ó Gráda 1991). In modern economics, the education of women regarding correct infant feeding is a key factor in efforts to improve health in the poor of India (Brennan et al. 2004). In a study of stature in the German military in the early twentieth century, direct correlations have been made between breast feeding and an increase in stature (Haines and Kintner 2008). Nutritional issues are greatest between the ages of six months and 3-4 years, when the benefits of breast milk diminish and environmental assaults come to the fore (Balam and Gurri 1994; Higgins 1989; Rousham and Humphrey 2002).

As mentioned, nutritional levels have traditionally been inextricably linked with human growth and stunted growth is intimately linked with both undernutrition and/or malnutrition (Brennan et al. 2004; Fogel et al. 1983). Any interference in the normal supply of food can impact on a population. In the past this may typically be related to famine or conflicts. As society has modernised however, it is economic factors which particularly have become more influential, and economic cycles play a very important role in influencing human growth (Woitek 2003, 255). The Great Famine in Ireland in the mid-nineteenth century was undoubtedly considerably worsened by the socio-economic factors of the day. Similarly, the physical bodies of Afro-american slaves, as mentioned earlier (**Section 5.3**), were moulded and formed by the economic realities of the time in early modern North America. However individual influence on nutrition cannot be underestimated, although in terms of looking at large groups or populations the impact may be less. There are numerous cases, in modern medical literature, of malnourishment in relatively affluent communities due to individual food preferences or parental misguidance (De Luna et al. 2003; Larralde et al. 2007; Narchi and Thomas 2000; Tamura et al. 2000).

Given the role that nutrition plays in influencing development and growth, it is to be expected that infection must be seen to have an intimate role. Pinhasi (2008) found that infection should be considered to be a highly influencing factor on stature, and that a synergistic relationship exists between nutrition and infection. As ever, the identification and prevalence of disease may be problematic (see **Chapter 7**). The globalisation of the world's economy, with the opening up of vast trading routes, also ensured the transmission of disease on a scale never witnessed before in human history. This was well illustrated with the transference of Old World infectious diseases, such as smallpox, from Europe to the Americas in the fifteenth and sixteenth centuries (Cook 1998). The threat has only increased with time and particularly with advances in transport links, and the effective development of a 'borderless' world (Cockerham and Cockerham 2010, 2).

The circumstances of occupations must be seen to be highly influential also. In the past, individuals may have been working from a young age and may have spent their entire lives in one particular occupation. The influence of such labour practices on other factors of life cannot be underestimated. In a comparison study in Portugal of medieval juveniles in Leiria and early twentieth century juveniles in Lisbon (Cardoso and Garcia 2009), it was found that, after puberty, the medieval children outgrew the later sample. This was linked to differential work practices and stresses, with the children in the early twentieth century being engaged in more strenuous activities which then had a direct impact on their final stature (ibid.). In another study of nineteenth century conscripts in Bavaria (Lantzsch and Schuster 2009), it was found that individuals engaged in hard manual labour were shorter than their contemporaries not involved in such work. However, it is possible that some of these studies may be biased by their very nature. Certain occupations may attract certain body-types. For example, taller individuals were frequently deliberately targeted for armies. Height minimums for entry into the army were introduced in England in 1755 (Floud 1994). However, it has been noted that minimum height requirements were often changed to suit circumstantial needs, as evidenced by the fluctuations in the statures required for boys admitted into the early nineteenth century Marine Society in London (Floud and Wachter 1982b).

It was noted earlier that statures in Britain fell soon after the Napoleonic Wars at the start of the nineteenth century. This has generally been linked with a growth in the economy at the time. Declining stature linked with economic growth, which may initially appear entirely contradictory in terms, has been noted in other studies also (Salvatore 2004; Alter et al. 2004; Haines 2004; Steckel 1994; Komlos 1986). While in the long term economic growth proved to be beneficial to populations, initially it appears that physically it compromised the health status of individuals, particularly those in the labouring and poorer classes. It appears that the working class of Britain, in particular, initially paid dearly for economic development (Floud et al. 1990, 305). However, eventually general economic well-being resulted in an increase in stature (Woitek 2003). This is undoubtedly combined with social improvements at the same time and an improvement in medicine (Wohl 1983). North America was exceptional in this regards. American statures increased in the late eighteenth century, at a time of significant economic development (Steckel 1994). American white males had reached modern stature levels in the late eighteenth century and were taller than Europeans. While there are a number of factors involved in this, the level of meat consumption (that is, protein consumption) appears to be significant. In the mid-eighteenth century, Americans were consuming meat at levels that were only achieved in Europe in the twentieth century (Fogel et al. 1983, 464). Interestingly, meat consumption has also been linked with height increases in nineteenth century France (Weir 1997; referenced in Steckel

2004, 222), while increased heights in a Bavarian study have been linked to a protein-rich diet of milk (Baten 2009).

The effects of economic development on the lives of people are a key to understanding the health of the eighteenth and nineteenth centuries. Prior to the 1900s rural children were consistently taller than their urban counterparts (Lewis 2002, 220). This was due to the advantages of living in isolation, with less dependence on outside economic factors. It has been referred to as the 'urban penalty' (Baten 2009, 179). In Britain and other European countries it was a combination of the sheer increase in the numbers of people flooding into towns and cities, the strains imposed on existing urban services and the subsequent implications for the inhabitants, and the overall decline in the health of those living in the cities that are the key factors. It was the level of industrialisation, and its subsequent consequences, that had the real impact on health rather than urbanisation itself (Lewis 2002, 221).

5.5 Stature Studies in Ireland

Ireland has been one of the areas particularly targeted by economic historians for assessment of stature. This is due to the fact that the Irish of the eighteenth and nineteenth century defied traditional teaching that linked an increase in real wages with advancement in health, particularly through growth and stature (Nicholas and Steckel 1997). In reality, most of the population of Ireland in the eighteenth and nineteenth centuries had little or no real wage income and in many cases existed at subsistence level. The poverty levels of the majority of the population have been well documented (for example see Mokyr and Ó Gráda 1988; Ó Gráda and Mokyr 2006b). Yet the Irish poor were noted, both in contemporary records and in modern studies, for their physical well-being (for example see Nicholas and Steckel 1997). The studies use the data from prisoners (Ó Gráda 1991), convicts and indentured servants (Nicholas and Steckel 1997; Oxley 2004), and military records (Ó Gráda and Mokyr 2006b; Mokyr and Ó Gráda 1994; Mokyr and Ó Gráda 1988). Despite the undoubted traumas of the Great Famine, this well-being appears to have continued well into the twentieth century, when the Harvard survey looked at the anthropology of the Irish people in the 1930s (Young et al. 2008). As mentioned earlier, certain employment categories may either have influenced growth rates of the developing child and the subsequent adult or, may have attracted or demanded certain heights in terms of growth adults (see **Section 5.4**). Therefore, the studies have inherent biases. However, the data that have emerged provide some very revealing information about these specific individual groups, typically drawn from the lower strata of society.

The tall statures were contrary to the economic situation. Time and again the Irish have been noted for their increased height over their British counterparts in particular. These studies include individuals from the poorest sections of society, such as transported convicts: precisely the people that may traditionally have been under significant nutritional stress. The paradox of the poverty-stricken, but tall, Irish peasant (Nicholas and Steckel 1997; Oxley 2004), contrasts starkly with the image of the waif-like inhabitants of the highly industrialised tenement cities of Britain (Wohl 1983; Jordan 1993). This may be one of the key factors in understanding why the height differences occurred. In 1841, just 14% of the Irish population lived in urban centres (Oxley 2004, 291). Certainly the nineteenth century urban environment was not conducive to health, and the lack of urbanisation in Ireland may have had an impact on the overall stature.

Cormac Ó Gráda and Joel Mokyr have undertaken considerable studies of the changes in Irish stature since the latter part of the eighteenth century (Mokyr and Ó Gráda 1994; Ó Gráda and Mokyr 2006b). They have particularly studied height records from military records. Ó Gráda and Mokyr established that the soldiers in their study group (the East India Company) were not, as might be assumed, just from the poorest class, but rather represent individuals from perhaps the lower half or two thirds of Irish society (Mokyr and Ó Gráda 1994). This was similarly found in studies of stature in the British military (Floud et al. 1990). Ó Gráda and Moykr found that Irish recruits were taller than the British, at least at the beginning of the nineteenth century. Notwithstanding that certain biases may be present in the results, the study indicates that despite Ireland's economic decline in the early nineteenth century, the Irish people were getting taller (Ó Gráda and Mokyr 2006b), and that prior to the famine the Irish poor were taller than their British counterparts (Mokyr and Ó Gráda 1994). The rise in stature, despite the economic downturn, is in stark contrast to evidence elsewhere (see **Section 5.4**).

This conflicts somewhat with an Australian study by Stephen Nicholas and Richard Steckel (Nicholas and Steckel 1997, 112ff). In their study of pre-Famine statures in Ireland (based on data collected from Irish-born convicts in New South Wales) they found that the growth spurt for Irish men was delayed and male statures began to decline in the 1790s until the

Great Famine. However, crucially, they were still taller than their English counterparts. In contrast, Irish females either maintained their statures or increased in height, in contrast to a decline in the height of English women after 1790 (ibid.). This has been mirrored in other studies also. In a study of prisoner statures in Clonmel prison in Co. Tipperary between 1845 and 1849, Ó Gráda found that both females and males were tall, particular in comparison to British data (Ó Gráda 1991). Nicholas and Oxley's study of female convicts in New South Wales found that the statures of English female convicts were shorter in comparison to the Irish and they attributed that to the lack of industrialisation in Ireland (Nicholas and Oxley 1993). In addition, they found there was less difference in height between rural and urban Irish dwellers (ibid.), not surprisingly perhaps when work by Mary Lewis has indicated that it was industrialisation and not urbanisation that was detrimental to human health (Lewis 2002). The findings of Nicholas and Oxley were disputed (Jackson 1996), but were later reaffirmed by the original authors (Nicholas and Oxley 1996). The rise in the statures of Irish convicts in comparison to their English contemporaries was earlier identified in a study of male convict heights in Australia (Nicholas and Steckel 1991).

The variation between the patterns of growth in Irish men and women noted above is just one of the considerations to take into account in stature studies. Certain generalisations may be made, for example, European heights have increased in recent centuries, but the generalisations can hide many layers of complexity. Regional differences in stature have been identified. It was noted earlier that some of the greatest variations in stature have been observed in populations in close proximity to each other (Wolański and Siniarska 2001), and this is believed to be primarily linked to the differing environmental conditions endured by different strata of society.

Deborah Oxley's study of Irish-born female convicts has revealed some interesting details regarding regional variations in stature, which appear to also be linked with social status associated with religion (Oxley 2004). She found that Ulster women were taller than any of their Irish contemporaries. Furthermore there were differences between the statures of women based on their religion. In the pre-1795 sample, it was found that Protestant women in Ulster were substantially taller than their Catholic counterparts, they were marginally taller in Connaught, there was no difference in stature in Munster, and in Leinster Protestant women were shorter than Catholic women (ibid., 279). Interestingly in contrast to the rest of the country, in Ulster the female Catholic stature caught up with the Protestant height in the nineteenth century, and this has been attributed to both a more diverse diet and lower population growth in that region (Oxley 2004, 287). In contrast, army data indicate that the males from Ulster were smaller than the rest of their Irish contemporaries (Mokyr and Ó Gráda 1994).

As with other populations, those in Ireland undoubtedly underwent cyclical growth patterns. Komlos (1993b) identified two specific cycles, with decreases in stature in the late eighteenth century and in the 1830s. However overall, during the late eighteenth and early nineteenth century, the Irish poor in particular, as evidenced by naval, military, and prisoner records, were taller than their closest contemporaries in Britain, which may primarily be an indication of living conditions. In John Komlos's study of the statures of servants in America, he linked a decline in English statures between the 1720s and the 1740s to population expansion in the 1730s (Komlos 1993a, 776). Interestingly, no such decline was observed in the Irish servants. Perhaps genetic predispositions were at play. Even in the 1930s the Irish were still 'accounted a tall person' (Hooton and Dupertuis 1955, 24). The apparent tall stature of the Irish was not to last. By the mid-twentieth century the Irish were the smallest in a broad study of statures in Europe (Garcia and Quintana-Domeque 2007). This is likely to be a reflection of the fact that while the diet became more varied in the post-famine period, it decreased in nutritional value (Clarkson and Crawford 2001, 109-110).

5.6 Bioarchaeological Expectations of the Present Study

The three groups in this study represent quite defined socioeconomic groups in post-medieval Ireland: one group from the workhouses, one from the middleclass, and one from an urban context (see **Chapter 4**). The development of the body and final stature, as has been shown above, is a highly complex aspect of the human experience, ultimately, though not exclusively, defined by the circumstances of life from the earliest stages. Most of the influences on growth may be beyond the control of the individual, or indeed the group or population, in question. Based on the information presented in this chapter, the study of the stature in the selected groups proceeded with a number of specific research questions. These included:

- Most studies indicate that stature decreased from the medieval period into the post-medieval period. Is there evidence of that in the present post-medieval group?
- There is a clear link between socio-economic status and growth. On the basis that the three groups represent relatively distinct socio-economic groups, how did the three compare and contrast with each other? It may be expected that the middleclass group would have a greater advantage over their poorer contemporaries, and particularly over the paupers in the workhouses. Is this the case?
- By necessity the above analysis is considered by sex. Research discussed earlier indicates that females and males may react differently to physiological stresses. Was there variation between the sexes in terms of the patterns of growth, both in terms of the transition from the medieval period to the post-medieval period, and in terms of the three groups? The sexes may be compared through the three groups and with contemporary populations in Britain and America of similar socio-economic statuses.
- Evidence from economic historians and other historical documents indicate that the Irish were taller than most of their British contemporaries in the eighteenth and nineteenth centuries. Clearly, the skeletal results could not be compared directly with the records of stature from the eighteenth and nineteenth centuries, as the datasets were different in composition. In addition, some of the archaeological sites may span a couple of centuries, in comparison to the very constricted time periods of the aforementioned studies. However, it was possible to compare the osteoarchaeological results from this study with other similar studies. Does the skeletal evidence support the traditional narrative in terms of a tall Irish stature?
- It has been shown that diminished stature is generally linked with a lower life expectancy. This aspect of analysis was particularly affected by preservation levels on site and biases in the archaeological record (see **Chapter 4**). Was there any indication of significance in correlations between age-at-death and stature?

The measurements and estimates that were used to examine these questions are detailed in **Section 4.2.2**.

5.7 Results of Analysis

The analysis is presented below with data on the stature analysis first and data on the femoral length analysis secondly.

5.7.1 Stature Analysis

It was possible to estimate the statures of 83 females and 116 males across the three groups. The average statures, including the minimum and maximum statures are provided in **Table 5.1**. As described earlier in **Section 4.2.2**, various bones were used to calculate statures, with priority being given to those with the lowest standard deviation. The standard deviation in **Table 5.1** is provided by Stata 10, the statistical package.

Table 5.1.
Estimated average statures and ranges of females and males, all groups,
(*N* = total number of individuals)

Sex	*N*	Average (cm)	Std. Dev.	Minimum (cm)	Maximum (cm)
Female	83	158.1	5.8	144.3	173
Male	116	170.3	5.7	154.2	183.2

The estimated female adult statures were then examined, separated out by group. The results are presented in **Table 5.2**.

Table 5.2.
Estimated average statures and ranges of females by group, (*N* = total number of individuals)

Site Class	*N*	Average (cm)	Std. Dev.	Minimum (cm)	Maximum (cm)
Workhouse	16	157.3	8.0	148	173
Middleclass	14	160.9	5.9	151.9	171.4
Urban	53	157.5	4.7	144.3	168
Totals	*83*	*158.1*	*5.1*	*144.3*	*173*

One-way analysis of variance between the groups statures indicated that there was no statistical difference between the females in the three groups (F (2,80) = 2.08, $p > 0.05$). The maximum difference between average statures was 3.6cm.

The estimated male adult statures were examined, separated out by group. The results are presented in **Table 5.3**.

Table 5.3.
Estimated average statures and ranges of males by group, (*N* = total number of individuals)

Site Class	*N*	Average (cm)	Std. Dev.	Minimum (cm)	Maximum (cm)
Workhouse	19	167.0	5.5	157.4	176.3
Middleclass	29	172.0	4.5	163.9	179.5
Urban	68	170.6	5.8	154.2	183.2
Totals	*116*	*170.3*	*5.7*	*154.2*	*183.2*

One-way analysis of variance between the male statures indicated that there was a statistical difference between the groups (F (2/113) – 5.01, p < 0.01). The maximum difference between the average statures was 5cm. The Bonferroni test indicated that the difference between the middleclass males and the urban males was not statistically significant (p = 0.7), the difference between the workhouse group and the urban group was marginally significant (p = 0.04), while the difference between the workhouse males and the urban males was highly significant (p = 0.007).

A comparison of the mean estimated heights of both sexes, divided by group, is provided in **Figure 5.2**.

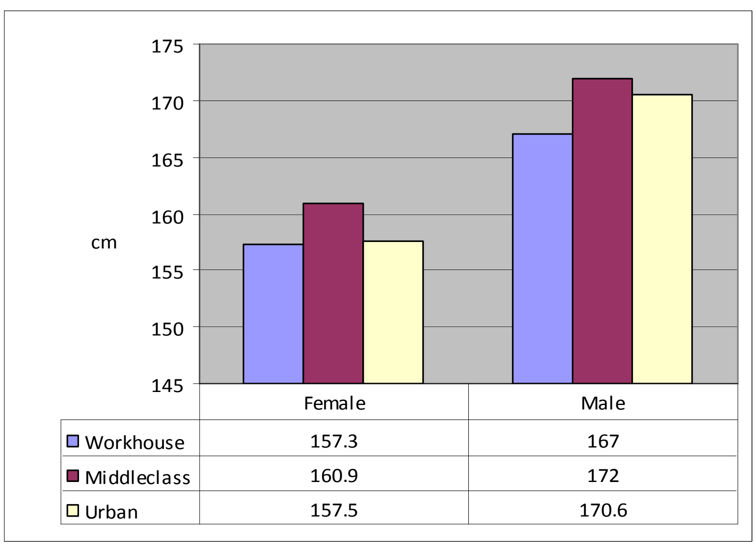


Figure 5.2.
Comparison of female and male estimated average heights in the three groups

The adults were divided into broad age categories of young adult (18-24 years), middle adult (25-44 years), and old adult (45+ years), (see **Chapter 4**). Stature was assessed by age-at-death and class status for each sex, in order to determine whether any group showed a link between premature death and stature. Unfortunately, the numbers within the young adult category were too low for viable statistical analysis (four females, ten males). The numbers within the middle adult group were relatively large (37 females, 59 males). However, no statistical differences were observed between the age-at-death of middle adult and the class status for either sex. As with the young adults, the numbers in the old adult category were too low for analysis (13 females, 16 males). Femur length was also examined in terms of assessing the age-at-death (below, **Section 5.7.2**).

5.7.2 Femoral Length Analysis

Data on the average femur length of the females in each of the three groups is provided in **Table 5.4**.

Table 5.4.
Female femur length by group, (*N* = total number of individuals)

Site Class	*N*	Average (mm)	Std. Dev.	Minimum (mm)	Maximum (mm)
Workhouse	8	402.5	16.1	375	422
Middleclass	10	431.4	24.3	395	471
Urban	31	420.9	17.0	395	461
Total	*49*	*420.0*	*20.2*	*375*	*471*

One-way analysis of variance of the average length of the femur between the groups and sexes revealed statistically significant differences between the three groups (F (2,46) – 5.49, $p < 0.01$). When assessed individually between groups there was no statistical difference in the femur lengths between the middleclass group and the urban group ($p > 0.05$), there was a nominal difference between the urban group and the workhouse groups ($p < 0.05$), and there was a significant difference between the workhouse group and the middleclass group ($p < 0.01$).

The average male femur length by group is provided in **Table 5.5**.

Table 5.5.
Male femur length by group, (*N* = total number of individuals)

Site Class	*N*	Average (mm)	Std. Dev.	Minimum (mm)	Maximum (mm)
Workhouse	13	442.7	24.8	402	485
Middleclass	12	460.9	17.5	424	488
Urban	38	456.8	25.7	390	504
Total	*63*	*454.7*	*24.6*	*390*	*504*

In contrast to the data on the female adults, there was no statistical significance to the variation between the femur length in the male individuals in the groups (F (2.60) – 2.13, $p > 0.05$). Consequently, none of the individual group comparisons were statistically significant ($p > 0.05$).

A comparison of the mean femur length of both sexes, divided by group, is provided in **Figure 5.3**.

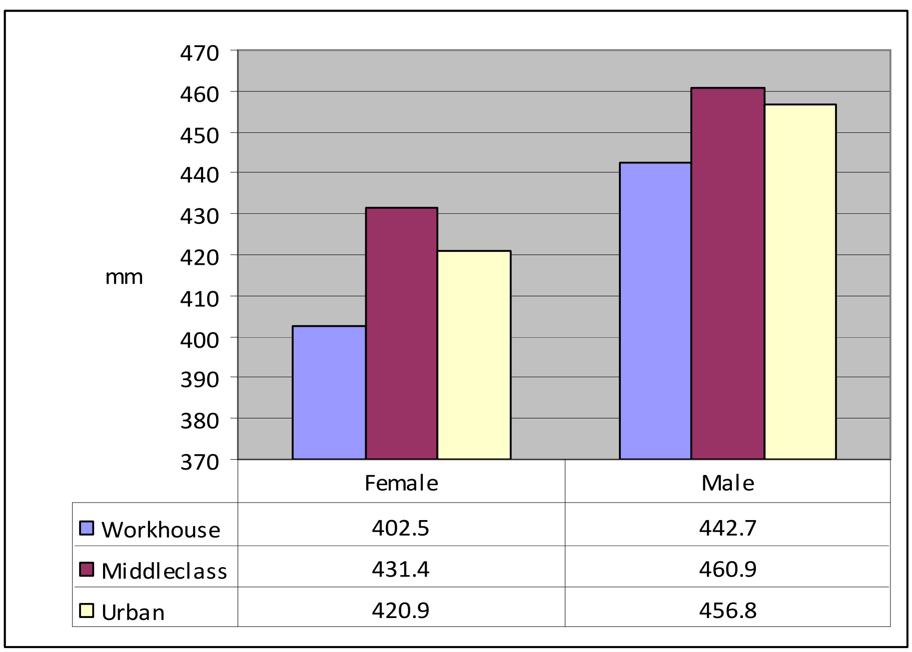


Figure 5.3.
Comparison of female and male average femur lengths

Analysis was also undertaken on the relationship, if any, between age-at-death and average femur length, for both sexes across the three groups, as was done with statures above (see **Section 5.7.1**). As it is acknowledged that skeletal stature estimates are precisely that (that is, estimated), it was surmised that assessing the more defined and finite measurement of the femur would provide more statistically viable results. However, similar issues arose regarding the assessment of comparisons of mean femoral length by age-at-death and class status for both of the sexes, as was encountered with the stature estimates. The numbers of individuals in the young adult group (one female, five males), and in the old adult group (five females, nine males) were too low for valid statistical analysis. The numbers in the middle adult groups were larger: 27 females and 38 males. Statistical variations were observed between the females by class status (F (2/24 – 6.84, p = 0.0045). The average female femur in the middle adult age category of the workhouse group measured 402.5mm, in the urban group it measured 421.9mm, while in the middleclass it measured 431.9mm. Statistically, there was no difference between the urban and the middleclass averages (p = 0.599). However, significant differences were observed between the workhouse/urban group (p =0.039) and between the workhouse/middleclass group (p = 0.005). No statistical difference was apparent between the average femur lengths of the middle adult males by age-at-death and class status category.

5.8 Discussion

It is clear that stature and socio-economic status are intimately linked, see **Sections 5.3** and **5.4** (Bogin 1988). Both historical data and contemporary studies indicate that the socio-economic status of an individual is a considerable influence on their development and final stature, and may be translated to the next generation. Environmental influences may be largely beyond the control of most individuals.

5.8.1 Stature Change from Medieval Period to Post-Medieval Period

Numerous studies by economic historians have indicated that the stature of Europeans fell from the Medieval period through to the Industrial period. This study looked specifically at the skeletal evidence of stature. The average female stature from this post-medieval study was 158.1cm, while the average male stature was 170.3cm. Skeletal populations from Irish medieval cemeteries can rarely be assigned into distinct socio-economic groups. This is due to a combination of factors including longevity of the cemeteries, and the sporadic nature of both the archaeological record and the documentary evidence. In any case, it could be argued that socioeconomic classes in the medieval period would not necessarily be immediately comparable with post-medieval data. Therefore, it was feasible to only compare general average statures across the two periods. How then, did the average statures compare with earlier medieval examples in terms of skeletal evidence?

Catryn Power undertook a large study of medieval and post-medieval stature estimates from archaeological skeletons from six Munster sites (Power 1994). The study used an unusual method of assessing the statures between the periods which entailed comparing the maximum mean female and male stature from one period with the maximum mean female and male stature from the other period. Using that method, she found that while the female statures remained relatively static between the periods, the male statures dropped. When her averages were combined to determine a single average for each of the sexes in the two periods, the post-medieval averages were remarkably similar to the present study. In the Munster study, the average female stature was 157.2cm (12 individuals) and the average male stature was 170.6cm (25 individuals), which represented 0.9cm difference from the females and 0.3cm of a difference from the males in the present study. Her study revealed an average medieval female stature of 157.8cm (37 individuals) and an average medieval male stature of 174.0cm (57 individuals) (Power 1994, 99). When these medieval averages were compared with the data from the present post-medieval study, the female stature were virtually remained unchanged, with a difference of just 0.3cm. In contrast, the male statures had dropped by 3.7cm into the post-medieval period. The finding mirrored that determined by Power (ibid.). The average medieval female stature from St Mary's Cathedral in Tuam, Co. Galway was 157.8cm (9 individuals), while the average male stature was 166.1cm (15 individuals) (Lynch 2005). This again suggested a minimal change in female stature between the two periods, with just 0.3cm of a difference between the medieval Tuam females and the post-medieval females in the present study. In contrast, the medieval male stature, as represented in Tuam, suggested a rise in the post-medieval period by 4.2cm. This was in contrast to the larger volume of data represented by Power's study above (Power 1994).

While the medieval Tuam males, selected for comparison with the present data, suggested that male statures increased from the medieval period through to the post-medieval period, in reality, the Tuam males may have been exceptional. The average male medieval stature from Tuam was 0.9cm less than the average male stature from the post-medieval workhouse group. The latter were significantly shorter in stature than their contemporaries. In contrast, when the present average post-medieval male stature was compared with both their contemporaries and medieval males in the Munster study, it indicated that the male stature declined from the medieval period through to the post-medieval. This conformed to the data already established from other records (see **Section 5.5**). It contrasted however with data revealed by the recent study on *Health and Disease in Britain*, which found there was little change in either female or male stature averages between the medieval and the post-medieval period (Roberts and Cox 2003, 308).

However, the situation regarding changes in female statures between the medieval and post-medieval period was different. There were negligible differences between the present post-medieval average female stature and the average medieval female stature from either the Munster study or the Tuam site. This suggested that there was little change in the female statures through those centuries. This lack of variation was also noted in the recent large study of health in post-medieval Britain (Roberts and Cox 2003, 208). It is possible that it was a reflection of increased access to better nutrition by females, in comparison to their male counterparts, through the time. This would have allowed females to maintain a steady height while their male companions decreased, quite substantially, in stature. As described earlier (**Chapter 3**) the first half of the post-medieval period was highly volatile and insecure, with significant political and social upheavals, while the second half became increasingly subject to severe food shortages. These would have resulted in significant stresses on the people, presumably which is why the male stature diminished. However, it would seem incongruous that females were somehow shielded and protected to such an extent that their heights were not also affected by the changes to the living environments. It is also possible that the variation is due to different rates of immigration. Certainly the latter half of the sixteenth and the first half of the seventeenth centuries saw a significant number of plantations (Lyttleton and Rynne 2009), which may ultimately have affected genetic pool. It was noted earlier (see **Section 5.3**) that males are typically more susceptible to the stresses than females. Perhaps that is what has shown through here. Females, by their genetic make-up, may have been physically able to cope better with the stresses experienced during those turbulent centuries.

5.8.2 Female Statures in the Post-Medieval Period

The average British post-medieval archaeological female stature has been calculated as 160cm (Roberts and Cox 2003, 308). This comprises 540 females, which includes data from one Irish site of 14 females. The average estimated female stature in the present study was 158.1cm. This suggests that, overall, the Irish females from the present study were slightly shorter than their contemporaries in Britain. This contrast with the evidence from the documentary records which indicates that both females and males were generally taller in Ireland than in Britain in the post-medieval period (see **Section 5.5**). However, this will be examined in more detail below. More telling data on the changes in stature in the post-medieval period may be gained by examining comparisons and contrasts between the three groups. No significant variation was found between the female average statures when compared between the three groups. The tallest average stature was in the middleclass group (160.9cm), while the workhouse and the urban group were very similar (157.3cm and 157.7cm respectively). The greatest difference between the statures was 3.6cm. While it appeared that the middleclass females were taller than their contemporaries, which would be expected given the socioeconomic rank, the difference was not statistically significant.

When the femoral lengths of the females in the three groups were compared, the results were somewhat different. There was a 28.9mm between the workhouse females and the middleclass females, with the workhouse having the shortest average femur length. The urban group fell in between the other two groups. There was no statistical difference in the femoral lengths between the middle class and the urban group, there were significant differences between the workhouse and the urban, while the differences between the workhouse and the middleclass were highly significant. Thus, while there were no real differences in stature between the groups, there were significant differences in the femoral lengths, with the workhouse varying significantly from the other two groups. This may be related to the fact that the statures are ultimately estimates, while the length of the femur is a specific measurement, perhaps highlighting that, ultimately, the workhouse females were indeed considerable disadvantaged in terms of height. This may only be tested with larger comparative material.

Somewhat surprisingly, the general comparison of estimated statures from archaeological skeletal remains indicated that the average Irish female stature was lower than the average British female stature in the post-medieval period. This was in direct contrast to studies of contemporary records of stature for the period (see **Section 5.5**). In order to examine the somewhat conflicting skeletal evidence, the individual groups were compared with a number of cemeteries of corresponding socioeconomic status. The workhouse group was the most comparable of the three groups as they formed such a discrete and unique population sample. There were very few comparable datasets in Ireland. The average female stature in the present workhouse population was 157.3cm. This was taller than the average of 155.7cm from the Connaught Asylum for females from Ballinasloe, Co. Galway (Rodgers et al. 2006, 102), and it was taller than the female average of 154.7cm from the workhouse in Thurles (Fibiger 2004). In reality, the number of individuals used in those two studies (<10 individuals) was too low for direct comparisons with the present study. The average stature of the workhouse females in this study was marginally shorter than the average of 158cm from the 160 females from Kilkenny workhouse (Geber and Murphy 2012, 517).

Table 5.6 provides data on female statures from comparable sites of low socioeconomic status from Britain with the current Irish workhouse group.

Table 5.6.
Irish workhouse female statures compared with other contemporary sites

Site	Description	Average Stature (cm)	Reference
Irish workhouses	*Present study*	157.3	
Cross Bones, Southwark, London	Lower class	158	(Brickley et al. 1999)
Newcastle Infirmary, Newcastle	Pauper cemetery	160	(Boulter et al. 1998; quoted in Roberts and Cox 2003)
City Bunhill, London	Lower class, possible high numbers of Irish immigrants	160	(Connell and Miles 2010)
St Bride's Lower Churchyard, London	Lower class, associated with Bridewell workhouse and Fleet prison	160.5	(Miles and Conheeney 2005; quoted in Kausmally 2008)
St Martin's-in-the-Bull Ring, Birmingham	Primarily working class	159.1	(Brickley et al. 2006)

All comparable cemeteries in **Table 5.6** were taller in stature than the Irish workhouse females. This was in direct contrast to numerous sources of evidence that indicated that the reverse was true. The Irish poor, particularly of the nineteenth century, were noted for their general health and well-being by many contemporary observers, and this was confirmed in terms of stature studies of a number of datasets by economic historians (see **Section 5.5**). However, the skeletal evidence contradicts this. The workhouse group in this study represent individuals that probably lived most, if not all, of their lives in the nineteenth century, as the workhouses were founded under the 1838 Poor Law Act. The living conditions of the poor degenerated significantly in the latter half of the eighteenth and the start of the nineteenth century, ultimately culminating in the Great Famine of 1845-1852. Perhaps the stresses encountered by the poor in this study were so severe that their final statures were ultimately compromised. It may be surmised that perhaps the pauper status of those females in the Irish workhouses did not represent the individuals that were included in the datasets of the economic historians. However, many of those datasets comprised convicts, and indentured servants, many of whom would have originated from the very lowest echelons of society. Similarly, the data from an actual pauper cemetery in Newcastle-upon-Tyne indicate those females were still almost 3cm taller than their female counterparts. This indicates that the Irish female paupers were shorter than their English contemporaries.

A number of studies have been carried out in North America of cemeteries of European-decent groups of low socioeconomic status. The average stature of females in a poor urban group from the late nineteenth century Legion of Honor [*sic*] cemetery in San Francisco was 161cm (Buzon et al. 2005), while the average stature of females in Uxbridge almshouse in Massachusetts was 163.4cm (Elia and Wesolowsky 1991). In Monroe County Almshouse in New York females averaged 160.5cm in stature (Higgins et al. 2002), while in Highland Park poorhouse they averaged 160cm (Steegman 1991). These were all taller than the average workhouse stature for the present study (157.3cm), and indeed were all taller than the average Irish post-medieval stature for females in this study of 158.1cm. This was despite the low socioeconomic status of the individuals in the aforementioned US sites. It must be acknowledged that at least some of the individuals in the American data are likely to be first-generation emigrants, including some individuals from Ireland, but there is likely also that there are individuals whose forebears emigrated to America generations before. In any case, the taller stature of the lower-class American females over that of their Irish contemporaries tallies with the data already assessed by economic historians (see **Section 5.5**).

The female stature of the urban group in this study was estimated at 157.5cm. As mentioned earlier, this was very similar to the female average from the workhouse. Given that the data above indicates that the workhouse group were smaller in stature than their British contemporaries, this may suggest that the urban group were similarly compromised in their health, in comparison to their contemporaries, despite the lack of industrialisation in Ireland. The low stature of the urban females may have occurred as a result both of general poor living conditions within the city environs, and also to the high levels of migrants coming into the city from rural areas in the eighteenth and nineteenth century. The present evidence suggested that the lower levels of society at that time were short in stature. The influx of such migrants from rural areas may have dictated the urban stature. It was also apparent, despite again the evidence of other researchers, that there was no difference in urban and rural heights (the latter as represented by the workhouses).

The middleclass group in this study was also a relative defined socioeconomic group, and could be compared with a number of contemporary sites. The comparisons are provided in **Table 5.7**.

Table 5.7.
Irish middleclass female statures compared with other contemporary sites

Site	Description	Average Stature (cm)	Reference
Irish middleclass	*Present study*	160.9	
St Marylebone, London	Middleclass	159	(Miles et al. 2008)
Christchurch, Spitalfields, London	Middleclass	156	(Molleson and Cox 1993)
Kingston-upon-Thames, London	Quaker middleclass	160	(Bashford et al. 2007)

In comparison to the evidence regarding the workhouse group, it appears that the middleclass females in Ireland were broadly comparable to their contemporaries in England. **Table 5.7** indicates that the Irish middleclass females were similar in stature to some of their English peers. In fact, they appear to have been taller than the females in the middleclass group from Christchurch in London. It is likely that the general comparability is reflective of similar living conditions, and also perhaps may reflect a little of the genetic inheritance between these groups. The paupers in the Irish workhouses were primarily, though not exclusively, native Irish and Catholic. In contrast the Irish middleclass, at least in the selected sites for this study, were primarily Protestant in origin, and may have had closer immediate links to England.

However, again it is noted that there was no statistical difference between the stature of the workhouse female group and the other female groups in this study, although femoral length suggest otherwise although this may only be tested should larger sample comparable Irish sample sizes become available. While the research of the economic historians is undisputed, the lack of differentiation in skeletal estimates of statures between any of the female averages in the socioeconomic groups in the present study ultimately presents a perplexing premise. Assessment of the contemporary records of data indicates that the Irish of the lower socioeconomic groups were taller than their British counterparts, both female and male. However, the skeletal evidence of stature provides evidence to the contrary, particularly in terms of the workhouse groups and also too with the mixed urban group. Even if the stature estimates did not necessarily pick up differences between the groups, the femoral lengths suggest at least that the workhouse females were compromised in terms of growth, and again, this contradicts the evidence of the economic historians. The middleclass Irish appear to compare favourably with their English contemporaries.

5.8.3 Male Statures in the Post-Medieval Period

The average post-medieval male from this study was 170.3cm. The average male stature in post-medieval Britain was 171cm (Roberts and Cox 2003, 308) which, as was found with the females, suggested that the Irish were marginally shorter in stature. Again, this would contrast with the evidence of the economic historians (**Section 5.5**).

As with the females, the middleclass males were the tallest, standing at an average of 172cm. In contrast, the average workhouse male was just 167cm. The average estimated stature of the urban male fell in between the other two groups at 170.6cm. There was no statistical difference between the males in the middleclass and the urban groups. However, the differences between the workhouse group and both the urban and middleclass groups were statistically significant, indicating the workhouse males were, on average, shorter than their contemporaries.

However, when the femora lengths were compared across the three male groups, no statistical difference was found. This was despite the differences in height that were apparent, and a maximum difference of 18.2cm between the average workhouse male femur and the average middleclass male femur. This contrasted with the data obtained for the females, which saw no statistical differences in height, but did reveal variations in femur length.

In order to assess the apparent differences in stature estimates in more detail, each male group was compared with skeletal data from some of their contemporaries in Britain, and also in North America. The average workhouse male stature was 167cm. This was 4cm shorter than the average stature of the 186 males from Kilkenny workhouse (Geber and Murphy 2012, 517). The males from the Irish workhouses are compared with some British data in **Table 5.8** below.

Table 5.8.
Irish workhouse male statures compared with other contemporary sites

Site	Description	Average Stature (cm)	Reference
Irish workhouses	*Present study*	167	
Cross Bones, Southwark, London	Lower class	169	(Brickley et al. 1999)
Newcastle Infirmary, Newcastle	Pauper cemetery	171	(Boulter et al. 1998; quoted in Roberts and Cox 2003)
City Bunhill, London	Lower class, possible high numbers of Irish immigrants	168	(Connell and Miles 2010)
St Bride's Lower Churchyard, London	Lower class, associated with Bridewell workhouse and Fleet prison	169	(Miles and Conheeney 2005; quoted in Kausmally 2008)
St Martin's-in-the-Bull Ring, Birmingham	Primarily working class	171.8	(Brickley et al. 2006)

As with the females, all of the comparable British male average statures were taller than the present sample of Irish males from the workhouses. Interestingly, the closest comparable site was that of City Bunhill in London, a site which is believed to contain a high number of Irish immigrants (Connell and Miles 2010). Thus it appears that Irish pauper males in this study were shorter in stature than both their contemporaries in Ireland (both in the groups in this study and in the Kilkenny workhouse referred to above), and their peers in Britain.

The same American sites referred to above in relation to females of low socioeconomic status were also examined for data on male statures. The males in the poor late nineteenth century Legion of Honor [*sic*] cemetery San Francisco averaged 171cm (Buzon et al. 2005), while the average stature of males in Uxbridge almshouse in Massachusetts was 169.7cm (Elia and Wesolowsky 1991). In Monroe County Almshouse in New York males averaged 171.9cm in stature (Higgins et al. 2002), while in Highland Park poorhouse they averaged 172.6 (Steegman 1991). Again, all were taller than the males buried in Irish workhouses. This conforms with previously assessed data that indicated that white Americans outgrew their European counterparts in the nineteenth century.

The data on the middleclass Irish males is presented in **Table 5.9** below.

Table 5.9.
Irish middleclass male statures compared with other contemporary sites

Site	Description	Average Stature (cm)	Reference
Irish middleclass	*Present study*	172	
St Marylebone, London	Middleclass	170	(Miles et al. 2008)
Christchurch, Spitalfields, London	Middleclass	168	(Molleson and Cox 1993)
Kingston-upon-Thames, London	Quaker middleclass	169	(Bashford et al. 2007)

The Irish middleclass males were generally taller than their contemporaries in Britain. In fact, there was a 4cm height difference between the middleclass Irish males and their contemporaries in one London site in Christchurch in Spitalfields. However, it is noted that all of the British data in **Table 5.9** is from London, and perhaps the often extreme environmental conditions of that industrial city (Wohl 1983) had a significant influence on final stature attainment.

Finally, the males from the mixed urban group had an average stature of 170.6cm. There was no statistical difference between the average urban male stature and the average middleclass male stature in this study. Not surprisingly then, the Irish urban male average is quite comparable to their contemporaries in middleclass England.

Despite the femoral lengths not displaying any statistical differences between the groups, comparisons of the stature estimates with similar British and North American data indicates variations in stature, and particularly the shortened stature of the workhouse males.

5.8.4 Age-at-death in Relation to Stature and Femur Length

Unfortunately, primarily due to a combination of poor preservation rates, and biases both perhaps in the cemeteries themselves and the excavations undertaken, there were not enough young adults to assess the premise that stunted growth can lead to an early death. Neither could the old adults be assessed. Only within the middle adult groups were the numbers large enough to assess any statistical variation in height between the various socioeconomic groups. None were observed in either the females or the males. This may suggest that mortality and stature were not linked in these groups, although the numbers available to assess were too low to derive any real conclusions.

The length of the femur was also examined, particularly as this represents a definite measurement rather than an estimation of stature from skeletal remains. Again however, the numbers of young adults and old adults were too low for assessment. Within the middle adult females, the length of the femur was significantly less in the workhouse group, when measured against the urban and the middleclass. No difference was observed between the latter two. No difference was apparent in the middleclass males. Unfortunately, there was no conclusive evidence to either confirm or deny any mortality bias in terms of either stature or the more specific femur length.

5.8.5 Stature in Post-medieval Ireland

It is evident that 'the biological development of the human being is always due to the interaction of both genes and the environment' (Bogin 1988, 109). The studies by economic historians, and others, referred to earlier, highlight the intense complexity of human growth and development, and the wide range of factors that may have an impact or impacts on it. The discrete cycles that can be traced through the late eighteenth and early nineteenth century records cannot be identified in the skeletal assemblages in this study due to the longevity in terms of the use-history. However, the intricacies of stature come clearly through in the skeletal record.

The assessment of the results of the analysis of the statures of these three specific post-medieval groups has revealed a number of intriguing points. It has been surmised that statures dropped from the medieval period through to the post-medieval period. While this was found to be true in terms of male individuals, females maintained similar statures between the two periods. The latter trait was also demonstrated in both sexes in archaeological skeletal studies in Britain. The drop in the male statures in the Irish data was therefore surprising, and may be a reflection both of the extreme overall decline in living conditions, at least for some socioeconomic classes, in Ireland through the centuries. It may also be connected to the increased susceptibility of male individuals in terms of reaction to stressors. The variation between the female and male changes in stature from the medieval through to the medieval period in Ireland has previously been noted in another study (Power 1994), and suggests specific factors were happening in Ireland in that period, that influenced stature changes. In addition, both the female and male average Irish stature was lower than the British equivalent in the post-medieval period. This directly contrasts to extensive research by economic historians on a variety of contemporary record sources from the post-medieval period.

An assessment of the females and males by group provided more detail on this perplexing finding. Statistically, there was no variation in female heights between the groups. This, combined with the similarity of those statures to the medieval data, suggests a remarkably static female population. However, when females in the workhouses were compared with their peers in both Britain and North America, they were found to be shorter in stature, but very similar to other Irish workhouse females. In contrast, the middleclass females were comparable in stature to their contemporaries in Britain. The males differed from the females within the group comparisons. The middleclass males appeared to be marginally taller than their contemporaries in Britain, while the urban group were as expected. However, as with the females, the males in the workhouses were shorter than other comparable groups in both Britain and North America, and they were also shorter than other workhouse males in a large sample from Kilkenny. Clearly, while the statistical significance of the stature estimates and the femur length differ, the workhouse paupers in this study appear to have been shorter than both their contemporaries at home and their peers abroad. Interestingly, in an anthropological study of the Irish in the 1930s, it was found that Church of Ireland individuals were taller than their Catholic contemporaries, with Presbyterians being the tallest of all at 173.3cm (Hooton and Dupertuis 1955). A number of British skeletal studies have found minimal variations between the statures of individuals of different socioeconomic status (Boyle et al. 2005; Brickley et al. 2006; Miles et al. 2008; Roberts and Cox 2003). This suggests that the short statures of the workhouse groups changed the overall averages to such a degree, that the overall average statures of females and males in post-medieval Ireland in the present study were reduced.

Protein is the key factor in terms of growth (Riley 2000) and a number of studies have observed that stature and protein-intake changes can be traced in historical records. Particularly this relates to meat, but it has also been noted in areas of high milk consumption (Baten 2009; Fogel et al. 1983; Steckel 2004; Weir 1997). One study specifically highlighted the potato as not influencing stature (Baten 2009). However, there is contradictory evidence. A study of health in industrial Sweden in the nineteenth century found that potatoes were very beneficial to health (Sandberg and Steckel 1997, 142, 143). This has also been suggested in terms of Irish populations (Clarkson and Crawford 2001; Mokyr and Ó Gráda 1994). 'Potatoes are almost the perfect nutritional package, supplying calories, high-quality protein, dietary fibre, and vitamin C' (Clarkson and Crawford 2001, 229). Potatoes lack vitamins A and D, but if they are combined with milk then the package is complete (ibid.). It is apparent that potatoes would have been the main food of the poor, particularly in the late eighteenth and first half of the nineteenth century (see **Section 3.3.1**). It would also have been the main food source for those individuals admitted to the workhouses. Combining the potato with milk or butter-milk forms the perfect diet. Yet those in the workhouses were still undersized.

Of course, there are biases within the stature data examined by the economic historians (see **Section 5.5**), data which had been much referred to in this study. Stature measurements were not scientifically obtained by those recording the heights of army and naval recruits, and of transported convicts and prisoners. Variations could occur, not least of all in terms of the season of measurement, but also even at the time of day. It has already been noted that certain occupations may have attracted certain heights, and it may be surmised that most of the convicts and indentured servants would have come from the lower echelons of society. However, overall, numerous economic historians have shown that the stature of the Irish, at least in the eighteenth and nineteenth centuries were tall in comparison to their British counterparts. The osteoarchaeological evidence suggests that those that died in the Irish workhouses may have been at the more extreme end of the scale, even within their own class.

The extreme disdain of the Irish toward the workhouses may have ensured that indeed only the most destitute and desperate sought admission, and that crucially it was the weakest of these that died in the institutions. Clearly the paupers dying in the workhouses physically paid the price in growth for their socioeconomic status. Whether it could be classed as stunting or adaptation is debatable. Interestingly however, it has been surmised that what may appear unhealthy to some groups may actually be a necessary compensatory adaptation by another group, which allows them to survive in extreme circumstances (Wolański and Siniarska 2001). Despite studies linking diminished stature to a decrease in overall physical health(Deaton and Arora 2009; Baten and Komlos 1998; quoted in Baten 2009), modern research suggests that increased height may not be linked to longevity and that short stature may in fact offer individuals some advantage where other factors, such as socioeconomic status, are not an issue (Samaras 2009; Samaras and Elrick 1999; Samaras and Elrick 2002). Clearly, in the case of the paupers from the workhouse sample in this group, their living conditions were abysmal, with the conclusion being for them to seek admittance to the dreaded workhouse system. Their deaths, within the workhouse system, suggest that they were the most physically compromised of their socio-economic group. Whether the short stature of those in the workhouses was an actual adaptation or classic stunting remains in question. Unfortunately, it is not possible to test for mortality variations in the various groups in terms of stature and age-at-death.

The next chapter will examine the evidence of caries and ante-mortem tooth loss in the three groups.

CHAPTER 6:
Caries and Ante-mortem Tooth Loss

6.1 Introduction

Dental enamel has long been acknowledged as the hardest substance in the human body. It is the most highly mineralised and the most dense of all of the calcified tissues (Robinson et al. 1986). As such, it survives excellently in most archaeological contexts. Yet this very hard substance is not totally immune to destruction. There are taphonomic factors that can erode it (Poole and Tratman 1978). It may also be worn down, either by the simple act of mastication, particularly when a coarse and gritty diet is consumed, or by occupational use of the teeth as a tool, or by cultural practices such as clay pipe-smoking. It may be fractured. It may also be subject to erosion in the form of caries, an infectious disease that dissolves the enamel (Lukacs 1989, 265). Carious lesions, which are strong indicators of a diet that includes high levels of sucrose and/or refined foods, are frequently studied in archaeological contexts. The study of these lesions, and the ante-mortem tooth loss which may be associated with the caries, can be a key factor in assessing the dietary intake of a given population.

Caries is one of the few diseases where the prevalence rate may be tracked through millennia, as the evidence may be preserved in archaeological skeletons (Freeth 2000; Whittaker et al. 1981). The rates are typically low in hunter-gatherer groups, who consumed a largely natural diet of meat, fish, and vegetable matter. A slight increase is noted with the introduction of farming, particularly linked with the processing and consumption of carbohydrate-rich grains. However, studies have indicated that the rates remained relatively low and steady for millennia through to the start of the post-medieval period (for example see Corbett and Moore 1976; Moore and Corbett 1971; Moore and Corbett 1973; Moore and Corbett 1975; and also Caselitz 1998; Lanfranco and Eggers 2012; Larsen 1997; Larsen et al. 1991; Steckel and Rose 2002). From that period onwards the prevalence rates increased. Crucially, the seventeenth century in particular saw the development of large-scale trading of sugarcane from the Americas to Europe. The levels of sugar in the diet began to increase. This was further compounded by the development of the sugar beet industry in Europe in the early nineteenth century. Sugar, both as a grocery in its own right and as an addition to other foods and commodities, became an integral part of the daily intake of people.

In the past 50 years rates have somewhat stagnated in modern industrialised societies, but this is attributed almost exclusively to the use of fluoride. Today the prevalence of the disease is extensively tracked. Now it is linked particularly with lower social classes and other disadvantaged groups (Sheiham 2001, 575; Moynihan 2000). This 'disease of civilisation', like others, is one of the costly consequences of modernisation. As Western society became more advanced and 'civilised' over time, so the frequency and severity of caries has increased (Eaton and Eaton 1999, 395; Lingström and Borrman 1999).

This chapter will move forward with an examination of tooth anatomy and how carious lesions are related to it (**Section 6.2**). It will then examine the aetiology of caries (**Section 6.3**), as well presenting an historical perspective on the progress of caries through time (**Section 6.4**). The bioarchaeological expectations of the present study are presented in **Section 6.5**. The methodology has already been described in **Section 4.2.3**. The results of the analysis are provided in **Section 6.6**, and are divided between carious lesions and ante-mortem tooth loss. Finally, a discussion of the results is presented in **Section 6.7**.

6.2 Tooth Anatomy and Caries

A tooth is made up of three basic elements: enamel (the crown of the tooth); dentine (the calcified tissue contained by the enamel and the cementum); and cementum (the tooth root). Carious lesions involve the dissolution of enamel and/or cementum through the demineralisation of its structure. It occurs as a result of the interaction of certain bacteria in the plaque with carbohydrates. Plaque is a natural colourless biofilm that overlies the surface of the teeth. The key factor in the development of carious lesions is the consumption of fermentable carbohydrates (Saunders et al. 1997; Hillson 1986). The fermentation of the carbohydrates by the bacteria produces organic acids as a waste product, and it is this acid that begins the process of demineralisation and decay (Hillson 1986; Robinson et al. 1986). The bacteria produce the acids all the time, but not to sufficient levels to instigate the demineralisation process of the enamel. It is only with the consumption of certain foods (see **Section 6.3**) that the production of the acids reach such levels as to begin demineralisation of the enamel (Sheiham 2001, 271).

The lesion begins as an area of opacity in the enamel, representing the demineralisation of the elements (Hillson 1986). At this stage the process may be reversed with remineralisation, particularly through the topical application of fluoride (Hillson 1986; Moynihan 2000; Moynihan and Petersen 2004; Sheiham 2001). The opaque stain may take two forms in a clinical environment. The first is as a white spot, which is an indication of active caries. The second is as a brown spot, which appears to indicate an arrested caries lesion (ibid.). It may take up to two years before a 'clinically detectable' cavity lesion develops (Newbrun 1982, 423). In fact, the disease may be considered to be in the late stages of its development by the time the actual cavity forms (Hillson 1986). As the disease progresses the cavity increases in size, firstly eroding though the enamel and/or the cementum, and then through the dentine. At that stage the pulp cavity of the tooth, containing the nerves and the blood vessels, may be breached. This exposes the tooth to bacterial infection, which can lead to the formation of a dental abscess. Finally, only the root of the tooth may remain, with the crown of the tooth completely dissolved. Typically the tooth may fall out or it may be deliberately extracted at any stage.

In the case of teeth that are lost to caries, the socket of the tooth will resorb and can heal over completely. This ante-mortem tooth loss is readily identifiable in archaeological remains. While it is impossible to definitively state that a tooth lost ante-mortem was lost as a result of caries, it may be argued that high rates of both caries and ante-mortem tooth loss (AMTL) in a single population may indeed be intimately linked, particularly if other factors, such as severe dental attrition, are relatively low. Both caries and ante-mortem tooth loss most commonly occur in the molars and premolars, and the severity of both increases with age (Larsen et al. 1991; Lennon et al. 1974; Van der Merwe et al. 2010c; Wasterlain et al. 2009). The fissures in the surfaces of the premolars and the molars make them particularly susceptible to carious lesions (ibid.). Gritty foods, as often seen in medieval, and earlier, diets, may wear down these fissures before the lesions have time to take hold. However, the disease could still take develop. When teeth are substantially worn down due to diet, caries will often tend to occur in the spaces in between the teeth as opposed to the occlusal surfaces of the teeth.

The presence of caries, and the associated tooth loss, may have significant consequences for an individual (Hillson 1986). The tooth becomes weaker and more susceptible to breakage as the disease progresses. Once the pulp cavity and the nerves of the tooth are exposed the sensitivity of the mouth may increase dramatically. The possibility of inflammation is high and the associated pain may be considerable. The exposure of the pulp to the possibility of infection could have lethal consequences. 'Teeth' was listed as a cause of death in the London Bills of Mortality from the seventeenth through to the nineteenth centuries (Roberts and Cox 2003, 329). In addition to the inherent dangers associated with infection, both the sensitivity of the mouth, and the ante-mortem loss of teeth may have consequences for the type of foods consumed and also on the overall health profile of an individual. This may establish a fairly devastating cycle, where the condition of an individual's teeth may influence what they consume, which has implications for their health (Hollister and Weintraub 1993). Rotting teeth were considered as a marker of poverty. However, it was not only in relation to health that teeth could be an issue. Teeth could also affect employment opportunities. Those joining the military were routinely examined for oral health, as not only could caries and tooth loss both interfere with eating and digestion, but they could also limit a soldier's ability to carry out basic functions such as tear open gun cartridges (Hammond 1863 quoted in; Slednick and Moore-Jansen 1991). In archaeological populations, even in relatively modern samples, the occupational use of teeth cannot be underestimated.

6.3 Aetiology of Caries

As early as the fourth century BC, the philosopher Aristotle, noted that 'soft, sweet figs adhered to the teeth, putrified and produced damage' (Newbrun 1982, 418). One of the earliest studies of carious lesions was undertaken by J. R. Mummery in the nineteenth century (Mummery 1869-70; after Larsen et al. 1991). He documented an increase in caries from early populations through to more recent advanced societies. However, he linked the increase to physiological factors. It was not until the late nineteenth century that the real importance of diet in the development of caries was fully realised (Larsen et al. 1991). Carbohydrates, and particularly sugar, are now widely acknowledged to be the primary cause of caries (Larsen et al. 1991; Sheiham 2001; Newbrun 1982; Moynihan 2000). Sugar, or sucrose, is a 'simple sugar'. It is readily metabolised by bacteria in the mouth, more so than complex carbohydrates (Larsen et al. 1991). Technically, it is the low pH level that occurs as a result of the ingestion of sucrose that encourages the development of caries as it 'disrupts the plaque ecology' (Sheiham 2001). The increase in caries through human history is intimately linked with the overall shift in the diet to an increase in carbohydrates, and particularly to refined carbohydrates (Goodman et al. 1984, 37) (see **Section 6.4**).

The disease has been found to be relatively negligible in hunter-gatherer populations (Hillson 1986). The unprocessed diet and the overall lack of carbohydrates (in comparison to modern consumption rates) ensured that the disease was relatively minimal in such groups. However, it was not unknown. Maize has been identified as the main causative factor for the increase in caries in native American pre-agricultural populations developing into agricultural societies, as maize contains a significant amount of sucrose (Larsen et al. 1991; Larsen 1983). However, the disease has been proven to increase most dramatically when sugars are introduced into the diet (Newbrun 1982). One of the most comprehensive studies of caries was undertaken on the inmates of a mental institution in Vipeholm in Sweden in the 1950s (Gustafsson et al. 1953). Groups of inmates were fed various diets over a period of time, containing different levels and types of sugars, and at different frequencies. It was found that sugar was highly cariogenic, and that frequent snacking in-between meals, particularly with sticky foodstuffs, accelerated the development of the disease (ibid.). Central in this is the practice of frequent snacking. A population may have a high rate of sugar consumption, but the frequency and severity of caries will depend on the manner in which that sugar is consumed (Newbrun 1982). Other studies have specifically indicated that non-milk extrinsic sugars are the most important fermentable carbohydrates in terms of the development of caries (Sheiham 2001). In a study on rats, perhaps unsurprisingly, cola, sucrose, and honey were found to be highly cariogenic (Bowen and Lawrence 2005). This focus on sugar is central to many studies, with clinical studies in particular highlighting the importance of sucrose. In affirmation of the importance of sugar to the development of caries Newbrun (1982) cited the condition known as Hereditary Fructose Intolerance. People with the condition cannot tolerate sweet foods and instead consume starchy foods such as breads and pastas. Carious lesions were found to be virtually absent in those individuals. 'The low prevalence of caries… indicates that starchy foods do not produce decay whereas sugary foods do' (ibid., 419).

However, although sugar is undoubtedly the primary cause of the caries, it is certainly not alone. It has been shown that diets that combine sugar and finely-ground and heat-treated starch, and diets of cooked starchy foods, can produce levels of acid that begin the process of demineralisation (Sheiham 2001, 271). Indeed, '…a mixture of starches and sugars is as cariogenic, weight for weight, as pure sugar' (Hillson 2000, 260). In the 1970s studies were undertaken on laboratory rats as on the effects of various foodstuffs on the dentition (Frostell and Baer 1971). They examined the level of caries that resulted from various starches in the diet. Caries scores decreased in frequency in the following order: sucrose; pregelatinised potato starch; unmodified potato starch; and hydrogenated potato starch derivative. While the most severe caries was clearly associated with the sucrose-rich diet, critically the study found that even the mildest processing of starch increased its caries-inducing properties (ibid.). Thus, caries may occur with diets where there is little or no sugar. High rates have been recorded in some human groups who would have had little, if any, access to sucrose (Liebe-Harkort 2012; Wasterlain et al. 2009).

Thus, while sugar undoubtedly is the primary cause of caries, processed carbohydrates appear to have the potential to be just as cariogenic. 'Starchy food debris that remains in the mouth may…be broken down by an enzyme, amylase, present in the saliva. This yields sugars which the plaque bacteria are able to ferment' (Hillson 1986, 286). High caries rates were recorded in a nineteenth/twentieth century named population sample from Coimbra in Portugal (Wasterlain et al. 2009). Yet that group have virtually no access to sugar. The diet consisted primarily of bread, green and dry vegetables, and potatoes (ibid.). In contrast, other studies have found that cooked staple starchy foods such as rice, potatoes and bread are of low cariogenicity to humans (Rugg-Gunn 1975; Rugg-Gunn 1993; Rugg-Gunn and Nunn 1999; Sheiham 2001, 579). The key to the development of caries is the amount of carbohydrates consumed and the frequency of that consumption. Certainly in archaeological samples then, sugar is just one of the considerations as possible causes. In populations that had little or no access to sucrose, other carbohydrate sources, which may traditionally be seen as low in cariogens, may in fact play a much more considerable role, particularly when the rate of consumption is taken into account.

Clearly diet is the most influential aspect in relation to the development and progress of caries. However, caries develops as a result of a complex interplay of a wide variety of factors that relate to physiological, behavioural, and environmental elements (Lukacs and Largaespada 2006). These have been excellently summarised by Larsen *et al.* (1991) and are illustrated in **Table 6.1**. There are numerous factors in **Table 6.1**, which would be beyond the conscious control of people, particularly in the past, prior to modern knowledge of dentistry and the process of dental disease. These include, for example, the actual composition of the bacterial flora in the mouth and the presence of fluoride. As mentioned earlier, diet is the primary element in the development of diet. However, what a person eats may be intimately controlled by a wide variety of factors. Diet, at least in many archaeological populations, may be strongly determined by an individual's position in society. In modern contexts poverty, and therefore a compromised lifestyle, have been intimately linked with both general poor health and a decline in oral health (Locker 2000). Such was the case in archaeological populations also. Certainly in the past social status dictated the type of food, and the quality and quantity of that food that was consumed by the various social levels. Diet was not always a matter of choice. Particularly among the poor it was simply a necessity for survival. Only the wealthy had the luxury of being able to pick and choose.

Table 6.1.
Factors involved in the formation of carious lesions (Larsen et al. 1991, 179)

Essential Factors	Modifying Factors
Teeth that are exposed to the oral environment;	Tooth morphology and size;
Presence of aggregrates of complex indigenous	Developmental enamel defects;
and bacterial flora;	Occlusal surface attrition;
Salivary glygoproteins and inorganic salts that	Food texture;
adhere to the tooth surfaces (dental plaque);	Certain systemic diseases;
Diet	Age;
	Hereditary;
	Salivary composition and flora;
	Nutrition;
	Periodontal disease;
	Enamel elemental composition;
	Presence of fluoride;
	Other local geochemical factors.

The process of development of caries may be influenced by numerous factors. These may differ between individuals within a single community, or between entire populations. Different prevalence's of caries have been observed between different socio-economic groups within a society and between females and males (Arantes et al. 2009; Delgado-Darias et al. 2006; Larsen et al. 1991; Saunders et al. 1997; Sutter 1995; Walker and Hewlett 1990; Whittaker and Molleson 1996). Factors such as geographical location may also play an important role in the development of caries. Caries rates are consistently higher, both in terms of archaeological and modern populations, in the north-eastern United States of America, an area which has very low levels of natural fluorides in the water (Saunders et al. 1997). Regional preferences in dietary traditions may also be an important factor (ibid.). Such regional variations in food consumption were clearly indicated in Ireland during the period of the Great Famine and afterwards in the work by Kennedy et al (1999).

Disease is a very important factor in terms of the development of caries (Hollister and Weintraub 1993). It is ultimately a cyclical and intimate relationship. A disease may influence or dictate what a person can or cannot consume. This may have implications for oral health, as well as for the disease process itself. The amended diet may encourage the further development of caries which has additional health implications and so it carries on. A similar relationship may be seen in terms of nutrition and infection (see **Chapter 7**). Interestingly, it has been found also that the severity of caries may be directly influenced by poor nutrition (Alvarez et al. 1988). In a modern study of Peruvian children of low socio-economic status, not only was chronic malnutrition linked with delayed eruption or the permanent dentition, but it was also linked to more severe caries in the permanent teeth later in life (ibid.).

6.4 Historical Perspectives of Caries

In general, the rate of caries was minimal in hunter-gatherer groups and rose slightly with the adoption of agriculture. It remained relatively steady from the Iron Age through to the Late Medieval period in Western industrialised countries. In the seventeenth century the rate started to increase dramatically. This increase has been linked specifically to an increase in sugar and refined foods in the diet from that period onwards (Newbrun 1982; Larsen et al. 1991). The disease continued to rise until the 1960s, albeit with documented slumps associated with the food rationing, particularly of sugar, during the two World Wars (Hillson 2000; Sheiham 1984; Toverud 1957). In recent decades the prevalence of the disease has somewhat stagnated, and this has been directly attributed to the use of fluoride, both in toothpastes, in water supplies, and as a topical measure (Sheiham 2001; Sheiham 1984; Moynihan 2000; Moynihan and Petersen 2004). Some clinical specialists claim that the disease was uncommon before 1850 (Sheiham 1984). However, archaeological evidence contradicts this assertion. The disease is certainly common in archaeological populations from approximately the seventeenth and eighteenth centuries onwards (Freeth 2000; Roberts and Cox 2003; Saunders et al. 1997, 80).

Caries prevalence in hunter-gatherer populations are generally considered to have been low, in comparison to the agriculturalists that followed afterwards (Larsen 1995; Larsen 1997). Pre-agricultural diets are estimated to have comprised just 1-2% sugar, in comparison to the estimated 20% of modern industrial diets (Eaton and Eaton 1999, 253). The consumption of a diet lacking in processed carbohydrates ensured that most hunter-gatherer groups had relatively low prevalences of caries. In addition consumption of a coarse diet (coarse in contrast to modern processed foods) can aid in the removal of plaque and it would also encourage the production of saliva through the increased level of chewing (Varrela 1991). Saliva has a neutral pH and an excess of it would counteract the low pH that results from the consumption of sucrose (ibid.; Hillson 1986). However, changes in caries rates from hunter-gatherers to farmers, and even within their own societies, were not universal. Caries prevalence rates decreased in a prehistoric population from Santa Rosa Island in Southern California when the diet changed substantially from cariogenic roots, tubers, and other plant foods to the intensive exploitation of fish (Walker and Erlandson 1986). Although caries rates are generally considered to have been low in hunter-gatherer groups exceptions have been observed. A significant rate of the disease (14% of teeth) was recorded in a hunter-gatherer group in Texas, and this was attributed to the high carbohydrate composition of local plant foods (Hartnady and Rose 1991). Similarly, just over 13% of teeth, examined from prehistoric forager-farmers (1600BC-AD200) from La Playa in northwest Mexico, had carious lesions (Watson 2008). It was expected that the rates would be lower in this population as they were not completely agricultural. The high rate was attributed to the use of highly cariogenic local wild resources such as the cactus (ibid.).

Overall, there is substantial evidence to support a rise in caries lesions with the development of agriculture (Larsen 1995; Larsen et al. 1991). This is particularly associated with the introduction of starchy maize into the diet which, when processed, encouraged an increase in caries. Maize contains sucrose, one of the main causative factors in the development of caries (**Section 6.3**). However, the adoption of agriculture did not universally result in a rise in caries. The introduction of rice, another starchy carbohydrate, into the diet of prehistoric people in southeast Asia did not lead to a rise in caries prevalence (Tayles et al. 2000). However, overall, the prevalence rates in Europe remained relatively low throughout the following millennia until the post-medieval period. There were, of course, variations. Caries prevalence rates of 5.9% of teeth, or 36.5% of adults, were recorded in late medieval Carmelite population from Scotland, which are entirely reflective of a low cariogenic diet (Kerr et al. 1988). In contrast, a late medieval population from Finland had 13.1% of teeth affected, or 54.6% of individuals (Varrela 1991). This prevalence was also considered low and it was attributed to significant levels of attrition (ibid.). A similar prevalence was considered high in a forager-farmer population from Mexico noted above. Not surprisingly, caries prevalence rates of 62% of teeth, or 92.6% of individuals, in an Iron Age population from Alvastra in Sweden were considered high (Liebe-Harkort 2012). The rate was attributed to a diet of processed starch including bread and porridge, but was certainly considered exceptional in terms of the date of the site (ibid.). In reality, the interpretation of the severity of the prevalence rates rests with the contextual background to the site. In some instances, it may be expected that caries prevalence levels should be negligible, and anything above that may be considered high. In other cases, particularly in populations from more recent centuries, it would be expected that the rates would be very high, given the known causative agents of caries and the changed in diet and food production in recent centuries.

The pattern of caries through time is not consistent, and evidence clearly indicates that sugar is not the only important factor in the development of caries (see **Section 6.3**). In modern clinical trials the onset of caries is inextricably linked with sucrose in particular. Sucrose, or at least its primary manifestation of sugar, has similarly been cited in numerous osteoarchaeological reports as the main cause of caries, along with the increased refinement of food, particularly flour, in the post-medieval period (Freeth 2000). Certainly, there was a considerable infiltration of sugar into the post-medieval diet and today the average person in the West consumes 25 times more sugar than an individual in the mid-eighteenth century (Clarkson and Crawford 2001, 4). The increase in sugar intake was initially particularly related to the development of the sugarcane industry in the Americas, and the subsequent development of the sugarbeet industry in Europe, which ensured that sugar became more available and cheaper. In addition to the actual consumption of sugar, it was increasingly added to other foods and drink, such as alcohol (Mahon 1991, 37), and also to other substances such as tobacco (Ó Gráda and Mokyr 2006b, 33). The latter was a particular demand of Irish customers (ibid.). In addition to the increased production and consumption of sugar, the period also saw considerable advances in the production of refined flours (Rynne 2006, 256ff). Rotting teeth and related tooth loss became an everyday occurrence, with extraction often favoured early on in life to avoid the inevitable later carious lesions.

Despite the considerable levels of sugar in the modern Western diet, the prevalence of caries is decreasing. Fluoride is virtually exclusively credited, apart from diet, as the only factor that may stop or slow down the progress of caries (Moynihan 2000; Moynihan and Petersen 2004). The reasons are threefold: fluoride reduces and inhibits dissolution of enamel; it can remineralise enamel; it reduces acid production (Sheiham 2001). However, there is evidence that fluoridation of water may be physiologically harmful, depending on the levels and length of exposure (Clarkson 1991). Although the practice of adding fluoride to water is applied in a number of countries, it is viewed as being a danger to health in many European countries (Griffin et al. 2008). The use of antibiotics may also have contributed to the decrease in caries (Sheiham 1984), but does not appear to be as effective in preventing caries as fluoride applications (Mariri et al. 2003). In any case, recent studies have indicated that actual brushing of teeth has very little affect on the progress of caries (Sheiham 2001). In modern contexts, it is the actual fluoride that is applied, either in toothpastes, in water, or topically that seriously hinders the formation of caries cavities (ibid.).

6.5 Bioarchaeological Expectations of the Present Study

Carious lesions form a unique pathological lesion in the human skeletal system, and the information that may be derived from its study is broad ranging. It is the distinctive nature of the lesions, combined with the manifestation of them on the hardest substance in the human body (thus on an element which tends to survive well in archaeological contexts), that makes caries an ideal factor for archaeological study. While the aetiology of the disease is still being studied in detail, the development of the disease is prominently linked with a diet of refined sugars and processed carbohydrates. In this study caries and ante-mortem tooth loss (AMTL) were specifically chosen for the inextricable link to diet, and for what it may reveal about the specific population groups in this study. The analysis was undertaken with a number of bioarchaeological expectations. These included:

- It has been surmised that, in general, the prevalence of carious lesions increased from the medieval period through to the post-medieval period, primarily as a result of changes in diet and in the manufacturing of food. Does the present study confirm this common assumption?

- How do the prevalence rates compare with British data? Britain had a considerably higher consumption of sugar than Ireland in the period in question, and it would be expected that the prevalence rates would be higher in British populations. Do the results of this study conform to this?
- Specific emphasis was placed on considering the prevalence rates between the groups. The three groups represent distinct socio-economic groups, particularly the individuals from the workhouse group and from the middleclass group (see **Chapter 4**). The diet of these individuals in the eighteenth and nineteenth century has been extensively documented. It is surmised that the variation in the diets, at least between the workhouse group and the middleclass group, would result in considerably different prevalence rates of the disease. Is this the case and what are the implications of the results?
- It may not always be possible to assess the progress of caries by age group in archaeological populations due to a variety of controlling factors (Wasterlain et al. 2009). These include small sample sizes and general problems in determining the age-at-death of the skeletal remains of adult individuals (ibid.). However, the limitations are less with regards to assessing the relationship between the prevalence rates of caries in females and males. A number of studies have indicated that caries may manifest differently in females and males, as a result of a variety of reasons. What is the evidence from the present study?
- Caries and AMTL are intimately linked. Therefore prevalence rates of AMTL were also extensively examined in order to compare the results with the prevalence rates of caries.

The prevalence rates used to examine these questions are detailed in **Section 4.2.3**.

6.6 Results of Analysis

The total numbers of teeth and individuals examined in the present study are presented in **Table 6.2**.

Table 6.2.
Total numbers of individuals with dental remains, and total numbers of teeth examined (*N = total number*)

	***N* teeth**	***N* individuals**
Cashel	290	19[2]
Manorhamilton	397	45[3]
Total Workhouse	*687*	*64*
St Mary the Virgin & St John the Baptist, Sligo	345	19
St Mary's, Clonsilla	125	6
Church St. (associated with St Canice's Church), Finglas	35	2
John's Lane, Waterford	79	4
Total Middleclass	*584*	*31*
St Anne's, Shandon	2141	119[4]
Total Urban	*2141*	*119*

6.6.1 Analysis of Carious Lesions

The total numbers of individuals with carious lesions is summarised in **Table 6.3**. The numbers of observable individuals only includes individuals with at least one tooth preserved. In addition, all individuals that were edentulous were excluded.

[2] two of these individuals were edentulous, and were excluded from the caries counts in **Section 6.6.1**
[3] eight of these individuals were edentulous and were therefore excluded from the caries counts in **Section 6.6.1**, while another four individuals had lost all the teeth through a combination of AM and PM tooth loss
[4] six of these individuals were edentulous, and were excluded from the caries counts in **Section 6.6.1**

Table 6.3.
Prevalence rates of total numbers of individuals with caries (*n*) and total number of individuals with observable dentitions (*N*), by group

	n	*N*	%
Workhouse	45	50	90
Middleclass	23	31	74.2
Urban	83	113	73.5
Total	*151*	*194*	*77.8*

The crude prevalence rate was strikingly similar in the urban and the middleclass groups (73.5% and 74.2% respectively), while it was higher in the workhouse group (90%), suggesting that the disease was more common in the latter population. The prevalence rates between the three groups were individually compared in order to determine if the original observations were statistically significant. The results are presented in **Table 6.4** below.

Table 6.4.
Chi square variances in caries prevalence of individuals with caries (*n*) by number of observable individuals (*N*), by group

Site Class	*n*/*N* (%)	Site Class	*n*/*N* (%)	Chi Square
Workhouse	45/50 (90)	Middleclass	23/31 (74.2)	$X^2(1) = 3.5484$, $p = 0.060$
Workhouse	45/50 (90)	Urban	83/113 (73.5)	$X^2(1) = 5.6297$, $p =$ **0.018**
Middleclass	23/31 (74.2)	Urban	83/113(73.5)	$X^2(1) = 0.0069$, $p = 0.934$

Somewhat surprisingly, only the rates between the workhouse and the urban group displayed any significant difference (highlighted in **Table 6.4** above). In order to further assess the differences between the populations the prevalence rates by total numbers of teeth affected by total number of teeth was also examined. This was to counteract the fact that an individual with one carious tooth would be scored the same as an individual with 20 carious teeth when the prevalence rates by individuals were considered. The count of caries (and ante-mortem tooth loss, see **Section 6.6.2**) by total numbers of teeth provides more sensitive information. The crude prevalence rates of caries by total numbers of teeth are presented in **Table 6.5** below.

Table 6.5.
Prevalence rates of total numbers of teeth with caries (*n*)
by total numbers of observable teeth (*N*), by group

	n	***N***	**%**
Workhouse	257	687	37.4
Middleclass	79	584	13.5
Urban	379	2141	17.7
Total	*715*	*3412*	*21*

As with the prevalence rates of individual cases, the prevalence of caries by tooth appeared to be relatively similar in the middleclass and the urban group (13.5% and 17.5% respectively), and appeared significantly higher in the workhouse population (37.4%). The prevalence rates were statistically compared by group to determine if any of the differences were significant. The results are presented in **Table 6.6** below.

Table 6.6.
Chi square variances in prevalence of teeth with caries (*n*)
by total of observable teeth (*N*), by group

Site Class	***n*/*N* (%)**	**Site Class**	***n*/*N*(%)**	**Chi Square**
Workhouse	257/687 (37.4)	Middleclass	79/584 (13.5)	X^2 (1) = 92.5747, *p* = **0.000**
Workhouse	257/687 (37.4)	Urban	379/2141 (17.7)	X^2 (1) = 115.8769, *p* = **0.000**
Middleclass	79/584 (13.5)	Urban	379/2141 (17.7)	X^2 (1) = 5.7189, *p* = **0.017**

The prevalence of the severity of caries lesions between each of the three groups was statistically significant (highlighted in **Table 6.6**). The workhouse caries prevalence rate by tooth (37.4%) was twice that recorded in either the middleclass group (13.5%) or the urban group (17.7%). The urban caries prevalence rate by tooth was higher in the urban group than in the middleclass group. This suggested that, while the prevalence of the disease by numbers of individuals affected revealed little difference between the three groups, the prevalence of the disease by total numbers of teeth was significantly different between the three populations.

Both the prevalence of individuals with caries and the prevalence of teeth with caries are presented in **Figure 6.1**. The higher prevalence rates in the workhouse group are clear, yet only the prevalence rates of the teeth affected were statistically significant, (apart from the workhouse/urban difference in **Table 6.4**).

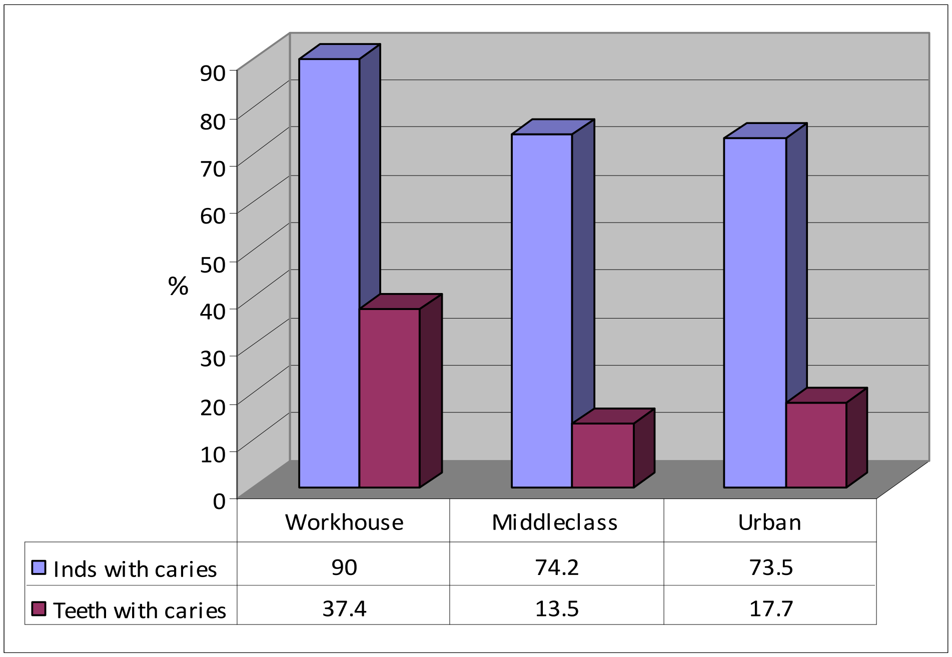


Figure 6.1.
Prevalence rates of individuals with caries compared with total teeth with caries, by group

It was possible that the high overall rates of caries were as a result of high numbers of older individuals in the various groups. This relates to the fact that, in modern clinical studies, the incidence of the disease increases with age. Therefore the age-at-death profiles of the individuals with dental remains were assessed. **Table 6.7** depicts the numbers within each category, while **Figure 6.2** presents the prevalence rates of the age-at-death profiles of all individuals with teeth from the three groups.

Table 6.7.
Number of individuals with dental remains, by age-at-death and group

Age Group	Workhouse	Middleclass	Urban	Total
Young Adult (18-24 years)	1	5	14	*20*
Middle Adult (25-44 years)	26	16	40	*82*
Old Adult (45+ years)	8	4	18	*30*
Total	*35*	*25*	*72*	*132*

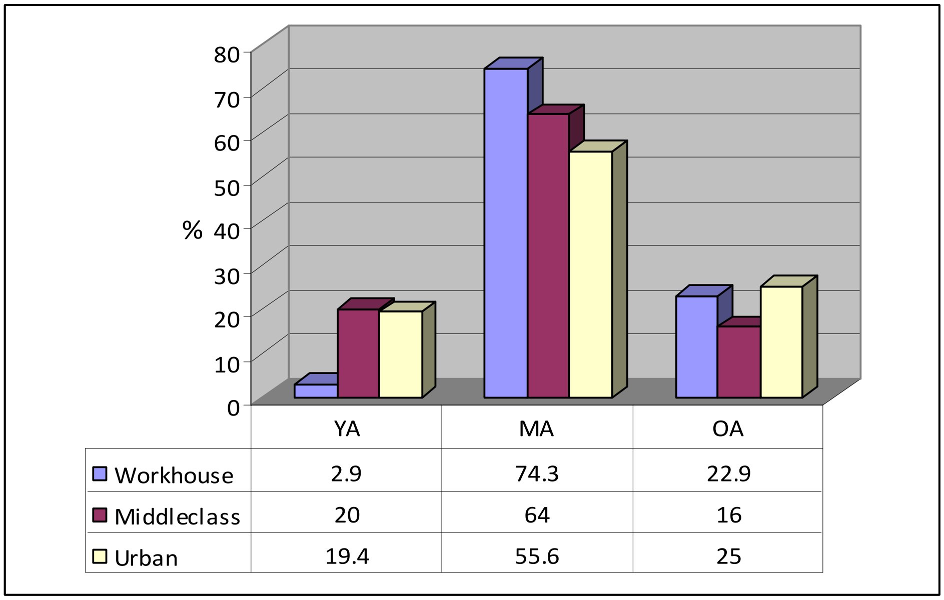


Figure 6.2.
Distribution of age-at-death profiles of adult individuals with dental remains[5]

There was no statistical difference in terms of the prevalence of individuals with dental remains by age group ($X^2(4) = 6.7645$, p = 0.149), which indicated that age-at-death was not a determining factor in terms of the prevalence rates of caries lesions.

The prevalence of caries by total numbers of female and male adults affected is presented below in **Figure 6.3**.

[5] YA – young adult 18-24 years, MA – middle adult 25-44 years, OA – 45+ years

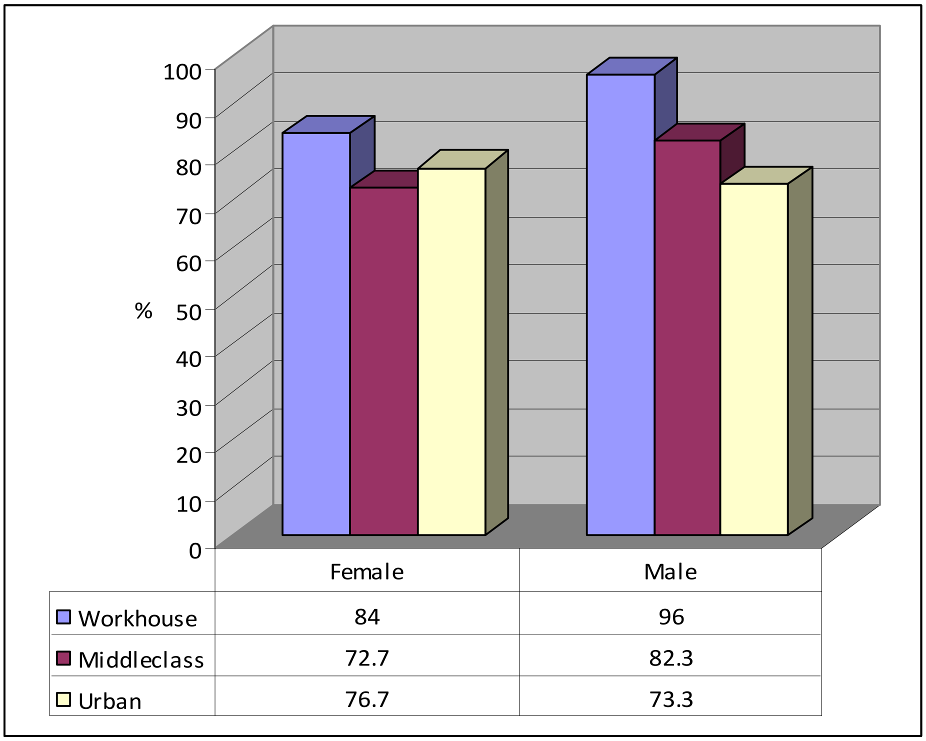


Figure 6.3.
Caries prevalence rates by numbers of individuals affected, by sex and by group

Male individuals were more commonly affected by caries in both the workhouse and the middleclass groups, while females had a marginally higher prevalence rate in the urban group. These prevalence rates were statistically assessed, and the results are presented in **Table 6.8** below.

Table 6.8.
Chi square variances in prevalence of individuals with caries (*n*) by total observable individuals (*N*), by sex and by group

Site Class	Females *n/N* (%)	Males *n/N* (%)	Chi Square
Workhouse	21/25 (84)	24/25 (96)	X^2 (1) = 2.000, p = 0.157
Middleclass	8/11 (72.7)	14/17 (82.3)	X^2 (1) = 0.3675, p = 0.544
Urban	33/43 (76.7)	44/60 (73.3)	X^2 (1) = 0.1544, p = 0.694

There was no statistical significance in the prevalence of the disease between in the total numbers of females and males presenting with the disease within the relevant groups.

The female and male carious teeth were assessed in terms of the numbers of teeth affected, by group and by sex, to assess any variations in prevalences. The prevalence rates of caries by observable teeth are presented in **Figure 6.4** below, and the statistical assessment of the results is presented in **Table 6.9**.

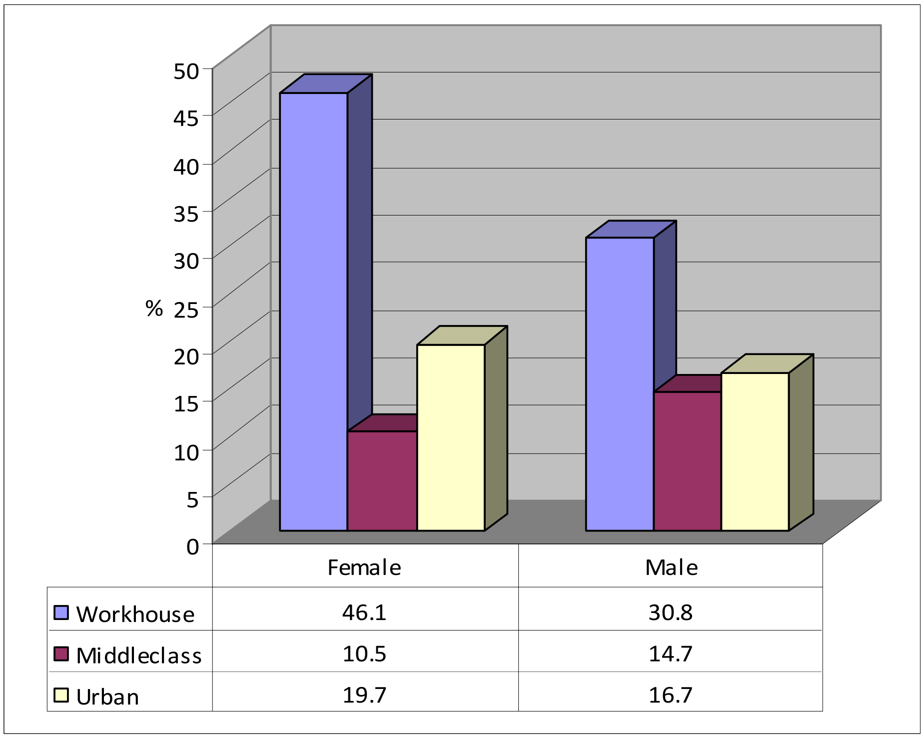


Figure 6.4.
Caries prevalence rates per numbers of observable teeth affected, by sex and by group

Table 6.9.
Chi square variances in prevalence of teeth with caries (*n*) by total observable teeth (*N*), by sex and by group

Site Class	Females *n/N* (%)	Males *n/N* (%)	Chi Square
Workhouse	137/297 (46.1)	120/390 (30.8)	X^2 (1) = 16.9858, p = **0.000**
Middleclass	19/181 (10.5)	53/361 (14.7)	X^2 (1) = 1.8322, p = 0.176
Urban	144/730 (19.7)	210/1258 (16.7)	X^2 (1) = 2.9032, p = 0.088

In the prevalence rates the female teeth were more commonly affected by caries in the workhouse and in the urban group, while male teeth were more commonly affected in the middleclass group. However, only the difference between the females and males in the workhouse group was statistically significant (highlighted above in **Table 6.9**).

The prevalence rates for each sex were than examined through the groups, in order to determine if either sex was more susceptible to caries in any specific group. These were assessed both in terms of numbers of individuals affected by caries and numbers of teeth presenting with caries. The female results are presented in **Tables 6.10** and **6.11**, while the male data results are presented in **Tables 6.12** and **6.13**.

Table 6.10.
Chi square variances in caries prevalence of numbers of females affected (*n*) by total observable females (*N*), by group

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	21/25 (84%)	Middleclass	8/11 (72.7%)	X^2 (1) = 0.6197, p = 0.431
Workhouse	21/25 (84%)	Urban	33/43 (76.7%)	X^2 (1) = 0.5091 p = 0.476
Middleclass	8/11 (72.7%)	Urban	33/43 (76.7%)	X^2 (1) = 0.0773, p = 0.781

Table 6.11.
Chi square variances in caries prevalence of numbers of female teeth with caries (*n*) by total observable female teeth (*N*), by group

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	136/297 (45.8)	Middleclass	19/181 (10.5)	X^2 (1) = 63.9338, p = **0.000**
Workhouse	136/297 (45.8)	Urban	144/730 (19.7)	X^2 (1) = 72.3259 p = **0.000**
Middleclass	19/181 (10.5)	Urban	144/730 (19.7)	X^2 (1) = 8.4085, p = **0.004**

In terms of numbers of females affected by caries, the prevalence rates were highest in the workhouse group (84%), slightly lower in the urban group (76.7%), and lowest in the middleclass group (72.7%). However, the differences between the various groups were not statistically significant (see **Table 6.10**). When the numbers of female teeth affected by caries was considered a similar pattern emerged. The rates were very high in the workhouse females (45.8% of teeth), the prevalence decreased in the urban group (19.7%), and was lowest in the middleclass group (10.5%). In contrast to the numbers of individuals affected, the variations in the numbers of teeth affected were all significant (see highlighted in **Table 6.11**).

Table 6.12.
Chi square variances in caries prevalence of numbers of males affected (*n*) by total observable males (*N*), by group

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	24/25 (96)	Middleclass	14/17 (82.3)	X^2 (1) = 2.1871, p = 0.139
Workhouse	24/25 (96)	Urban	44/60 (73.3)	X^2 (1) = 5.6667 p = **0.017**
Middleclass	14/17 (82.3)	Urban	44/60 (73.3)	X^2 (1) = .05798, p = 0.446

Table 6.13.
Chi square variances in caries prevalence of numbers of male teeth affected (*n*) by total observable male teeth (*N*), by group

Site Class	*n/N*(%)	Site Class	*n/N* (%)	Chi Square
Workhouse	120/390 (30.8)	Middleclass	53/361 (14.7)	X^2 (1) = 27.3672, p = **0.000**
Workhouse	120/390 (30.8)	Urban	210/1258 (16.7)	X^2 (1) = 36.8329, p = **0.000**
Middleclass	53/361 (14.7)	Urban	210/1258 (16.7)	X^2 (1) = 0.8344, p = 0.361

The pattern of caries prevalence in male individuals across the groups varied slightly from the females. Again the workhouse males (96%) were more frequently affected by caries than their counterparts in the middleclass (82.3%) and the urban group (73.3%). Somewhat surprisingly, the middleclass male individuals had a higher prevalence rate than those in the urban group. Only the prevalence rates between the workhouse males and urban males were statistically significant however (see highlighted in **Table 6.12**). The male prevalence rates by tooth broadly matched the female results. The highest rate was present in the workhouse males (30.8%), it decreased in the urban group (16.7%), and was lowest in the middleclass males (14.7%). The prevalence rate of caries by tooth was significantly higher in the males in the workhouse group over their contemporaries in the middleclass and urban groups, but there was no statistical significance in the difference between the middleclass and urban males.

6.6.2 Analysis of Ante-mortem Tooth Loss (AMTL)

The relationship between caries and ante-mortem tooth loss (AMTL) is complicated. It is impossible to categorically state that any or all teeth that were lost ante-mortem were lost as a result of caries. The evidence has essentially been lost. However, when high prevalence rates of caries are evident in a population it is possible that much of the ante-mortem tooth loss in the population may have occurred as a result of caries. This may occur directly through actual loss of the tooth or indirectly through extraction. AMTL was examined in a similar manner to caries above (**Section 6.6.1**). The numbers of individuals with at least one tooth lost ante-mortem is presented in **Table 6.14**.

Table 6.14.
Prevalence rates of total numbers of individuals (*n*) with AMTL by total number of observable individuals (*N*), by group

	n	***N***	**%**
Workhouse	56	64	87.5
Middleclass	11	26	42.3
Urban	83	119	70
Total	*150*	*209*	*71.8*

The AMTL prevalence rate by individual in the middleclass group (42.3%) was lower than those in the other two groups, with the highest prevalence occurring in the workhouse population (87.5%). The three groups were cross-compared to assess any significance in prevalence. The results are presented in **Table 6.15** below.

Table 6.15.
Chi square variances in prevalence of individuals with AMTL (*n*) by total observable individuals (*N*), by group

Site Class	***n*/*N* (%)**	**Site Class**	***n*/*N* (%)**	**Chi Square**
Workhouse	56/64 (87.5)	Middleclass	11/26 (42.3)	X^2 (1) = 19.8483, p = **0.000**
Workhouse	56/64 (87.5)	Urban	83/119 (70)	X^2 (1) = 7.1814 p = **0.007**
Middleclass	11/26 (42.3)	Urban	83/119(70)	X^2 (1) = 7.0464, p = **0.008**

Statistically significant differences were apparent in the prevalence rates of ante-mortem tooth loss across all three groups (highlighted in **Table 6.15** above). The workhouse individuals (87.5%) had a higher prevalence of AMTL than the individuals in both the middleclass (42.3%) and the urban groups (70%), while the urban individuals had a significantly higher prevalence of AMTL than those in the middleclass group. As with the caries above (**Section 6.6.1**), the prevalence of AMTL by observable socket was also assessed. **Table 6.16** presents that data.

Table 6.16.
Prevalence of sockets showing ATML (*n*) by total observable tooth sockets (*N*), by group

	n	***N***	%
Workhouse	699	1494	46.8
Middleclass	89	702	12.7
Urban	490	2712	18.7
Total	*1278*	*4908*	*26*

Each of the groups was cross-compared to assess the variations. The results are presented in **Table 6.17** below.

Table 6.17.
Chi square variances in prevalence of sockets showing AMTL (*n*)
by total observable sockets (*N*), by group

Site Class	*n*/*N* (%)	Site Class	*n*/*N* (%)	Chi Square
Workhouse	699/1494 (46.8)	Middleclass	89/677 (12.7)	X^2 (1) = 228.0270, p = **0.000**
Workhouse	699/1494 (46.8)	Urban	490/2712 (18.7)	X^2 (1) = 391.8322, p = **0.000**
Middleclass	89/677 (12.7)	Urban	490/2712 (18.7)	X^2 (1) = 9.2636, p = **0.002**

As with the comparisons between the numbers of individuals affected by AMTL above, the differences in prevalence rates between all cross-comparisons of the three groups were statistically significant (highlighted in **Table 6.17** above). The individuals in the workhouse had a higher prevalence of AMTL (46.8%) than those in the middleclass and urban groups (12.7% and 18.7% respectively), while the urban group had a higher prevalence of tooth loss than those in the middleclass group.

A summary of the prevalence rates of ante-mortem tooth loss in the three sample populations is provided in **Figure 6.5**. All of the differences were statistically significant.

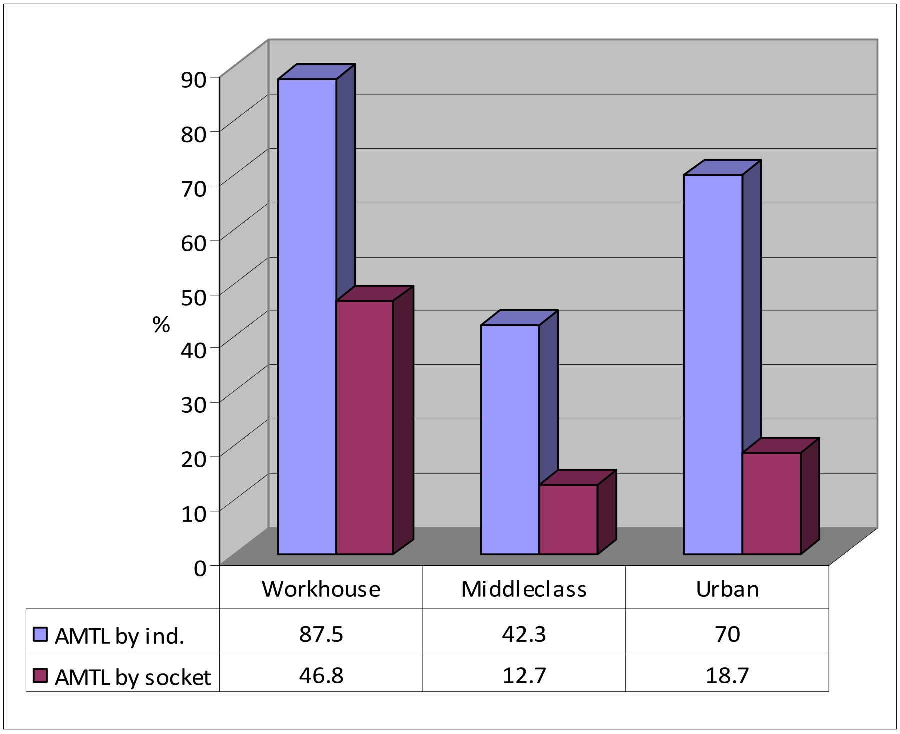


Figure 6.5.
Prevalence rates of individuals with AMTL, and AMTL by socket, by group

Ante-mortem tooth loss was also examined in terms of the levels of prevalence in females and males by individuals affected. **Figure 6.6** presents the results.

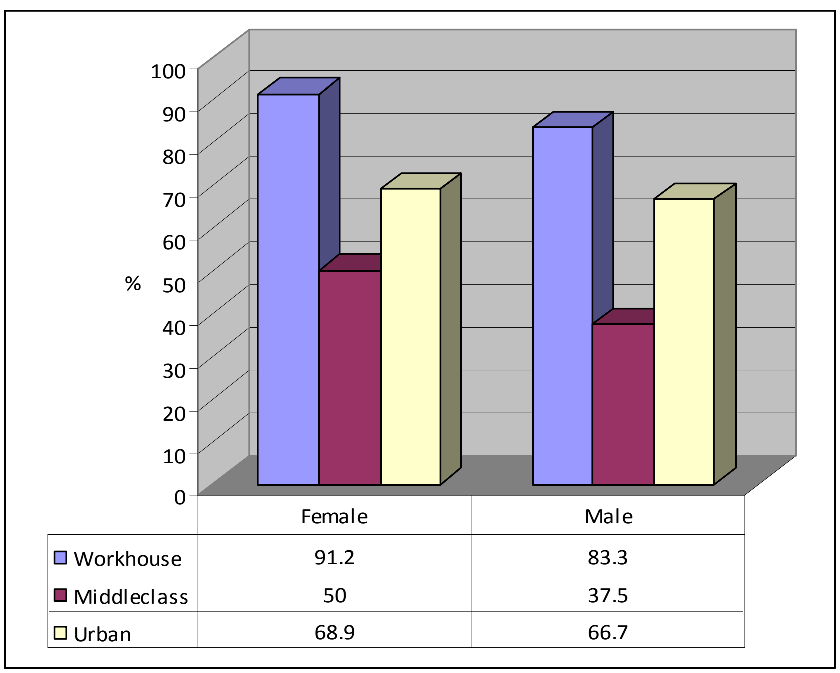


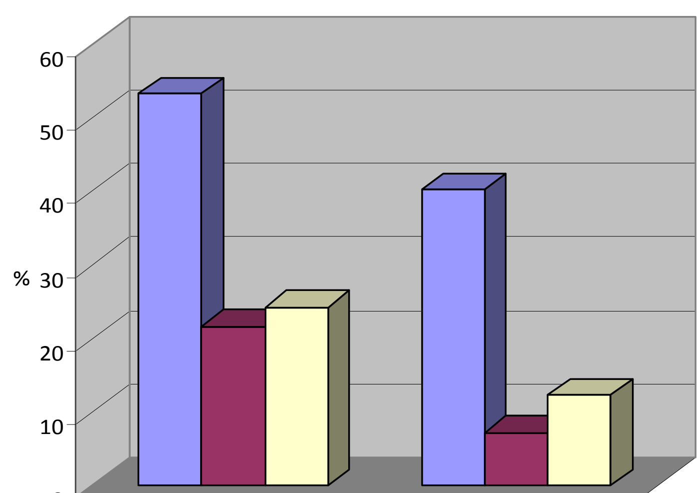
Figure 6.6.
Prevalence rates of AMTL by sex, by prevalence of individuals affected

In the case of all three site types, the prevalence rates by individuals affected by AMTL were higher in the females than in the males. The prevalence rates were then assessed to determine if the variations were statistically significant. The results are presented in **Table 6.18** below.

Table 6.18.
Chi square variances in prevalence of individuals with AMTL (*n*) by total observable individuals (*N*), by sex and group

Site Class	Females *n/N* (%)	Males *n/N* (%)	Chi Square
Workhouse	31/34 (91.2)	25/30 (83.3)	X^2 (1) = 0.8964, p = 0.344
Middleclass	5/10 (50)	6/16 (37.5)	X^2 (1) = 0.3939, p = 0.530
Urban	31/45 (68.9)	42/63 (66.7)	X^2 (1) = 0.0592, p = 0.808

Although the prevalence rates of AMTL by individuals affected was higher in females over males in all three groups, the results were not statistically significant (see **Table 6.18**). The prevalence of AMTL by sex was similarly examined by the total numbers of observable sockets. The results are presented in **Figure 6.7** below, and the statistical assessment of the results is presented in **Table 6.19**.



	Female	Male
Workhouse	53.3	40.3
Middleclass	21.7	7.3
Urban	24.3	12.3

Figure 6.7.
AMTL prevalence rates by numbers of observable sockets, by sex and group

Table 6.19.
Chi square variances in prevalence of sockets showing AMTL (*n*) by total observable sockets (*N*), by sex and group

Site Class	Female *n/N* (%)	Male *n/N* (%)	Chi Square
Workhouse	396/743 (53.3)	303/751 (40.3)	X^2 (1) = 25.1627, p = **0.000**
Middleclass	56/258 (21.7)	30/407 (7.3)	X^2 (1) = 28.8150, p = **0.000**
Urban	248/1020 (24.3)	185/1503 (12.3)	X^2 (1) = 60.5981, p = **0.000**

In comparison to the prevalence rates of AMTL by observable individuals, all of the differences in AMTL by observable socket in **Table 6.19**, where statistically significant. In all three groups, females had a higher rate of AMTL by observable socket than their male counterparts.

Each sex was also examined by group to determine if there were any statistical significant variations. These were assessed both in terms of numbers of individuals affected by AMTL and the numbers of teeth lost ante-mortem. The female results are presented in **Tables 6.20** and **6.21**, while the male data results are presented in **Tables 6.22** and **6.23**.

Table 6.20.
Chi square variances in AMTL in females (*n*) by all observable females (*N*), by group

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	31/34 (91.2)	Middleclass	5/10 (50)	X^2 (1) = 8.8072, p = **0.003**
Workhouse	31/34 (91.2)	Urban	31/45 (68.9)	X^2 (1) = 5.6964, p = **0.017**
Middleclass	5/10 (50)	Urban	31/45 (68.9)	X^2 (1) = 1.2910, p = 0.256

Table 6.21.
Chi square variances in AMTL prevalence in female sockets (*n*)
by total observable female sockets (*N*), by group

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	396/743 (53.3)	Middleclass	56/258 (21.7)	X^2 (1) = 77.1768, p = **0.000**
Workhouse	396/743 (53.3)	Urban	248/1020 (24.3)	X^2 (1) = 155.7520, p = **0.000**
Middleclass	56/258 (21.7)	Urban	248/1020 (24.3)	X^2 (1) = 0.7727, p = 0.379

When the numbers of females affected by AMTL loss was considered, the very high rate in the workhouse females (91.2%) was significantly greater than those in the middleclass (50%) and the urban group (68.9%) (see highlighted in **Table 6.20**). There was no statistical significance in the difference between the latter two rates. Similarly, the high AMTL by observable socket in the females in the workhouse group (53.3%) was significantly higher than the equivalent prevalence rates in both the middleclass (21.7%) and the urban (24.3%) females (see highlighted in **Table 6.21**), while there was no significance in the differences between the latter two rates.

Table 6.22.
Chi square variances in AMTL in males (*n*) by all observable males (*N*), by group

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	25/30 (83.3)	Middleclass	6/16 (37.5)	X^2 (1) = 9.9749, p = **0.002**
Workhouse	25/30 (83.3)	Urban	42/63 (66.7)	X^2 (1) = 2.8028, p = **0.094**
Middleclass	6/16 (37.5)	Urban	42/63 (66.7)	X^2 (1) = 4.5526, p = **0.033**

Table 6.23.
Chi square variances in AMTL prevalence by male sockets (*n*)
by total observable male sockets (*N*), by group

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	303/751 (40.3)	Middleclass	30/407 (7.3)	X^2 (1) = 140.0940, p = **0.000**
Workhouse	303/751 (40.3)	Urban	185/1503 (12.3)	X^2 (1) = 232.0708, p = **0.000**
Middleclass	30/407 (7.3)	Urban	185/1503 (12.3)	X^2 (1) = 7.8168, p = **0.005**

Significant differences were apparent between the males across all three groups, both in terms of AMTL by observable individual and by observable socket. A high prevalence of AMTL by observable individuals was recorded in the workhouse males (83.3%). This was higher than both the middleclass (37.5%) and the urban group (66.7%), while the latter prevalence was significantly higher than the former (see highlighted in **Table 6.23**). When the numbers of teeth lost ante-mortem was considered, again the prevalence rates were significantly higher in the workhouse males (40.3%), in comparison to both the males in the middleclass group (7.3%) and the urban group (12.3%). The latter differences were also statistically significant.

Finally, the numbers of edentulous individuals were assessed and the results are presented in **Figure 6.8**. None was edentulous in the middle-class group, while 5% of observable individuals were edentulous in the urban group. In sharp contrast, over 15% of the workhouse population had lost all of their observable teeth ante-mortem. The difference between the prevalence rates in the workhouse and the urban group was statistically significant ($X^2(1) = 5.8419$, p = **0.016**), with the prevalence rates three times higher in workhouse dentitions than in the urban (15.6% and 5% respectively).

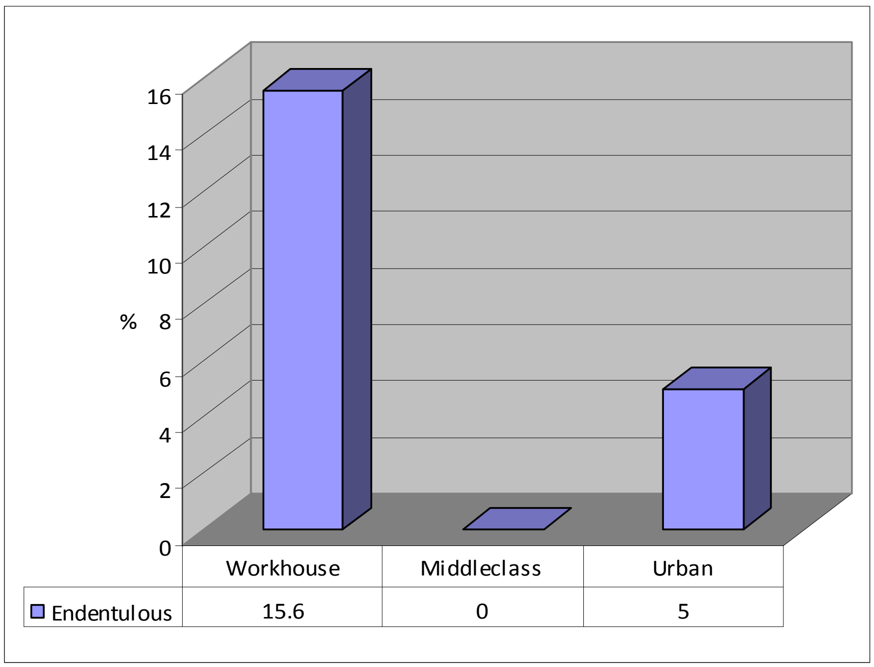


Figure 6.8.
Prevalence rates of edentulous individuals, by group

6.7 Discussion

The prevalence rate of caries by individual in this post-medieval study was 77.8% (151/194), with 21% or 715/3412 of teeth involved. How does this compare with the prevalence of caries in medieval Ireland? Evidence indicates that, at least in Britain, the prevalence of caries increased in the post-medieval period (Roberts and Cox 2003, 396). It is rarely possible to assign specific socio-economic statuses to entire cemeteries in the medieval period, or indeed to older cemeteries. In contrast, post-medieval cemeteries may frequently be associated with defined socio-economic groups, for example, African-American slave cemeteries in the United States of America. Initially the comparison of data from cemeteries where the socio-economic status is not clear, with skeletal populations whose socio-economic status may be known might appear meaningless. However, particularly with regards to differences in the prevalence of caries between the medieval period and the post-medieval period, the key factor regards the place of a cemetery in time and not primarily the socio-economic status of those buried there. This is due to the profound change in diet that occurred in the post-medieval period, with essentially the modernisation of both food production and consumption in that period.

How then did the overall prevalence of caries in this post-medieval study compare with data from the preceding medieval period in Ireland? A summary of a selection of caries prevalence rates in Irish medieval populations is provided in **Table 6.24**, and is compared with post-medieval data, including the present study.

Table 6.24.
Prevalence rates of caries by teeth and observable individuals
in selected medieval and post-medieval Irish populations (*n* = with caries, *N* = total observable)

	***n* caries/ *N* teeth**	**Prevalence (%)**	***n* caries/ *N* observable inds**	**Prevalence (%)**
Medieval				
Combined Munster sites (Power 1994)	184/4334	4.2	76/303	25.1
St Mary's Cathedral, Tuam, Galway (Lynch 2005)	54/440	12.3	14/21	66.7
Post-medieval				
Combined Munster sites (Power 1994)	59/676	8.7	22/49	44.9
Present study totals	*715/3412*	*21*	*151/194*	*77.8*

Catryn Power's study of a large selection of medieval and post-medieval populations in Munster found that there was a general rise in caries between the two periods, both in terms of prevalence by individuals and prevalence by tooth (Power 1994) (**Table 6.24**). The caries prevalence recorded in medieval skeletons from St Mary's Cathedral in Tuam, Co. Galway (Lynch 2005) was higher than in their contemporaries in Power's study (Power 1994). The Tuam skeletons have previously been noted with regards to stature (see **Section 5.8.1**) as being unusual in terms of their contemporaries. Overall, the caries prevalence rates in the present study (both by individuals and by tooth) exceed those established by

Power (1994) for combined post-medieval Irish populations. When the medieval prevalence rates for caries by tooth in **Table 6.24** is combined (238 carious teeth/4774 observable teeth, 5%), and compared with the results from the present study (715 carious teeth/3412 observable teeth, 21%), the difference is significant (X^2 (1) = 493.3644, p = **0.000**). Thus there was, as expected, a significant rise in the prevalence of caries from the medieval period in Ireland through to the post-medieval period.

In Britain, the post-medieval caries prevalence rate was 43.1% of individuals (366/850) and 11.2% of teeth (1451/12933) (Roberts and Cox 2003, 326). Both of those prevalence rates were almost doubled in the present study. The high rates in the present study of both the prevalence of caries by individual and the prevalence of the disease by tooth, in comparison to the British data were statistically significant (X^2 (1) = 76.4161, p = **0.000** and X^2 (1) = 222.6170, p = **0.000**, respectively). Therefore, the prevalence rates of caries in Ireland in the post-medieval period were significantly higher than comparable material in Britain. It has been shown that the consumption of refined sugars is intimately linked with the development of caries (see **Section 6.3**). In the 1780s the average rate of consumption of sugar per head per annum in Ireland was 5.3lbs, which was a third of the consumption rate in Britain (Clarkson and Crawford 2001, 51-52). Sugar consumption was intimately linked with tea drinking. By the 1820s tea consumption in Ireland was 0.48lbs per head per annum. This was less than a third of the consumption rate in Great Britain which stood at 1.70lbs (Ward 1994, 52). Therefore, the significantly higher prevalence rate of caries in Ireland in comparison to Britain in the post-medieval period is somewhat surprising. However, the possible causative factors are examined in more detail below.

How did the caries prevalence rates of each of the three individual groups in this study compare with their contemporaries, not only in Ireland but further afield also? Unfortunately, in terms of post-medieval cemeteries, there is little comparable published material in Ireland. Most of the comparable data is from British cemeteries, where there are a large number of excavated sites of individuals of known socio-economic status. A large Quaker burial ground, dating from the later seventeenth century to the early nineteenth century, was recently excavated at Kingston-upon-Thames in London (Bashford et al. 2007). Just 5.4% of their teeth (219/4149) had carious lesions (ibid.). Another middleclass named population, excavated at St Luke's Church in Islington in London, had similarly low prevalence rates, with 9.7% (219/2249) of teeth affected by caries (Boyle et al. 2005, 208). In contrast, in a subsample of named individuals from the middleclass group of eighteenth century skeletons excavated at Spitalfields in London, the rates were higher: 17.5% of teeth (371/2114) had carious lesions (Whittaker and Molleson 1996). The prevalence rate from the Spitalfields site is quite comparable with both the middleclass group (14.3% or 83/582 of teeth) and the urban group (17.5% or 397/2161 of teeth) in this study. The former would be expected to be similar to middleclass groups identified in Britain, as both the diets and the living conditions would be similar. The Irish urban group in this study (see **Section 4.5**) represents a mixture of individuals: rural and urban, rich and poor, healthy and sick. The caries prevalence would be expected to reflect that diversity: it would be expected to be neither very high nor very low. This was the finding of the current study. In particular, it also reflects the fact that Cork is a port city, with the added advantage of making certain foodstuffs and commodities (such as sugar) more accessible to the urban population than to an isolated rural community. Therefore, both the middleclass and the urban prevalence rates of caries were largely comparable to other contemporary populations.

The prevalence rate of caries by tooth in the workhouse group (37.4% or 257/687 of teeth) in the present study was significantly higher than in the other two groups. Nine out of ten individuals suffered from the disease. How did the prevalence rate of caries by tooth within the workhouse group compare with other similar sites? There are few published similar sites in Ireland. Carious lesions were reported from a small sample of skeletons recovered from Thurles workhouse in Co. Tipperary with a prevalence rate of 37.5% or 18/48 teeth (Fibiger 2004). In a recent study of skeletons from Tuam workhouse in Co. Galway, there was a caries prevalence rate of 24.3% (114/469) of teeth (Lynch 2012b, 20). While the Thurles site was comparable to the present data, the Tuam prevalence rate was lower. More comprehensive comparative material comes from Britain. A prevalence rate of 16.7% (31/186) of teeth was recorded in a cemetery excavated from St Andrew's Church in Worcester city, which was associated with a poor and low socio-economic parish (Western 2006). That rate was considered high in that population, when compared with contemporary sites (ibid.). A portion of the parish cemetery of St Mary and St Michael in Whitechapel, London was recently excavated, with the results forthcoming. Initial research has indicated that 80% of adults had caries (Henderson 2010). That rate is very high, and comparable with the 90% of individuals recorded in the workhouse group in the present study. Unfortunately, data on the prevalence of caries by tooth was not available at the time of writing. Interestingly, this low socio-economic status parish was notorious for its high numbers of Irish immigrants. The poor buried in Crossbones cemetery in London displayed a caries prevalence of 25.9% (161/621) of teeth (Brickley et al. 1999). A caries prevalence of 37.4% of female teeth and 27.3% of male teeth (numbers were not reported) were recorded in the individuals recovered from Monroe County poorhouse in Rochester in New York (Higgins et al. 2002). A large number of the inmates were of Irish origin (ibid.). A prevalence rates of 43% (34/80) of individuals was recorded in a pauper cemetery associated with the Legion of Honor [*sic*] in San Francisco (Buzon et al. 2005).

The evidence indicates that the prevalence rate of caries in the Irish workhouse group was high, certainly in comparison to their contemporaries in Ireland, while the rates were either comparable to, or higher than, other groups of low socio-economic status both in Britain and in the United States. High prevalence rates of caries, and indeed of ante-mortem tooth loss, may not typically be expected in individuals that were forced to depend on charity for their existence, as those who died in the workhouse were clearly forced to do (Higgins and Sirianni 1995, 132). This expectation is primarily linked to the association of the development of caries with the consumption of refined sugar in particular, which was essentially a luxury grocery until the end of the nineteenth century.

The role of sugar in the formation and development of caries has been stressed by numerous studies, particularly those with a clinical background (see **Section 6.3**). Honey was the primary sweetener in Ireland for millennia (Mahon 1991). Although sugarcane had been available from the Far East for many centuries, it was primarily the reserve of the wealthy. It was only in the seventeenth century that sugarcane, and specifically processed sugar, began to be exported on a mass scale from the New World back to Europe. Despite the cheap labour costs involved with the labour of slaves, the expense involved in exportation ensured that sugar remained a luxury commodity. It was not until the nineteenth century, with the development of the European sugar beet industry, that sugar began to be consumed by the general population on a massive scale. In addition in Britain, tariffs on imports were removed in the latter half of the nineteenth century (Corbett and Moore 1976). The love affair with sugar grew exponentially. Perhaps even more striking is the fact that the British consumed twice as much sugar as the their counterparts in America in the nineteenth century (Sutter 1995). A significant increase in caries in American military samples dating to the first half of the nineteenth sample (21.7% of teeth in a sample from the 1860s, compared with just 11.9% of teeth in a similar sample dated to 1814) has been partially attributed to influxes of European migrants (Slednick and Moore-Jansen 1991). By 1900 sugar consumption in England was almost five time higher than it had been in 1850

(Sheiham 1984). In Ireland, sugar consumption rose tenfold between 1859 and 1904 (Clarkson and Crawford 2001, 245). This was mirrored in evidence of caries from the 1930s, when cavities were recorded in the dentition of 99.2% of men (Hooton and Dupertuis 1955, 68). However, sugar was not initially as common in the Irish diet as it was in Britain. In the 1780s sugar consumption in Ireland averaged between 5.3-5.8lbs per person, a third of what it was in Britain at the time (Clarkson and Crawford 2001, 52-53; Mokyr and Ó Gráda 1988). Undoubtedly sugar featured large in the diets of those who could afford it in Ireland, as is clearly indicated in eighteenth and nineteenth century household returns, and from evidence of imports (Clarkson and Crawford 2001, 51, 52). In addition, people living in port cities, such as Cork was, and is, may have had more accessibility to sugar imports than their rural counterparts.

Sugar was a highly desirable grocery in the post-medieval period. In 1830, Daniel O'Connell, the Catholic Emancipator, wrote in the Fourth Letter on the Repeal of the Union: 'there is not one article the consumption of which tends more to health and comfort than sugar. Every person who can afford to do so consumes as much sugar as he conveniently can…[its] consumption increases with wealth; its diminution is the most decisive proof of poverty' (Mokyr and Ó Gráda 1988). The consumption of sugar in tea was perhaps the primary mode of consumption for the majority of the population that could afford it. Tea and sugar were staples of the poor in England by the beginning of the nineteenth century, yet in Ireland they remained luxury items (Gray 1993a). Until the 1830s, tea consumption was largely confined to urban workers and wealthy farmers: those who existed at subsistence level tended to prefer to spend any money on tobacco (Gray 1993a, 266, 267). However, from the 1830s onwards tea drinking filtered down to the labouring classes (Clarkson and Crawford 2001). The tea was consumed thick with sugar, with the concoction often being described as 'syrup-like' (ibid.). However, although sugar was obviously highly desirable, it was largely beyond the reach of many prior to the middle of the nineteenth century, and certainly beyond the means of the paupers buried in the workhouses.

It must be presumed that the workhouse group in this study had little or no access to sugar in the diet, certainly in comparison to those in the other groups. The Poor Law Inquiry of 1836 looked at the condition of the poor in Ireland, in a study prior to the setting up of the Poor Law Union system. The foods commonly consumed by the poor were quantified. These are summarised below (**Figure 6.9**). Sugar was not listed, suggesting that it was a very marginal luxury commodity. Certainly then prior to the Great Famine of the mid-nineteenth century, sugar played a miniscule role in the diet of the Irish poor. By the start of the nineteenth century the diet of the poor had been marginalised to an enormous degree into a few basic foods, namely potatoes, supplemented with various forms of milk (skimmed milk and buttermilk in particular), oatmeal, and occasionally herrings (Clarkson and Crawford 2001; Kennedy et al. 1999). Sugar, certainly prior to the mid-nineteenth century, would not have played a large or significant part in the diet of the paupers, both before and after entering the workhouse.

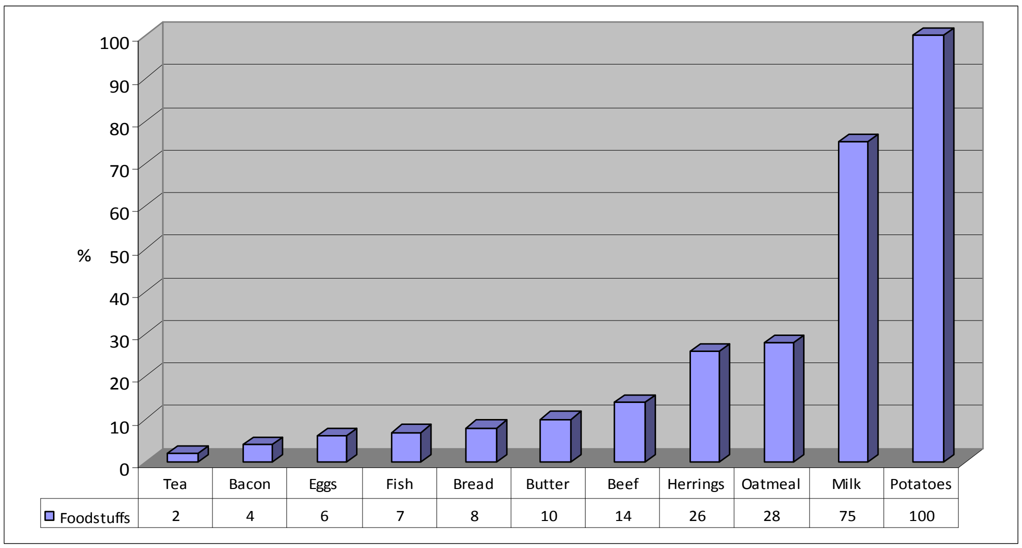


Figure 6.9.
Reported food consumption of poor in Ireland, Poor Law Inquiry, 1836
(Clarkson and Crawford 2001, 76, Table 4.5)

Herein lies the problem with the traditional association of caries with sugar consumption: those in the workhouses would have had minimal access to sugar both prior to and after entering the institutions, yet they still had a high prevalence of caries. The urban and middleclass caries rates were largely as expected, and compare favourably with other similar groups from the post-medieval period. This is despite the fact that the cemeteries examined in both of those groups represent individuals who were buried anywhere between approximately the seventeenth and the nineteenth centuries (**Chapter 4**). However, the exceptionally high caries rates from the workhouses were somewhat unexpected. The rates were not as a result of greater numbers of older individuals being in the workhouse and thus skewing the prevalence rates. Clearly, the paupers would have had minimal access to sugar, both in their lives outside of the workhouse, and in the time they spent in the workhouse. It was only in the 1880s that sugar was introduced into the workhouse diet and its widespread adoption within the system would have been slow

(Clarkson and Crawford 2001, 189). In addition, the workhouse cemeteries date from the 1840s onwards, when the institutions were founded. Therefore, most of the paupers were probably born from approximately 1800s onwards. As noted earlier, sugar really only began making inroads into the diet of the poor in the 1830s and in reality it was only towards the end of the nineteenth century that sugar became a common grocery for the majority of people in Ireland. Both time and circumstances ensured that any exposure the paupers had to sugar was absolutely minimal.

Modern clinical date almost dismiss 'other' carbohydrates in the development of caries, and hold refined sugars as exclusively responsible (Moynihan 2000; Moynihan and Petersen 2004). The populations in the current study date from the seventeenth through to the nineteenth century and the caries prevalence in all three population groups were high, with very high rates recorded in the workhouse group. This challenges the traditional, clinical view of caries in two regards. Firstly, it clearly indicates that carious lesions played a significant part in Irish populations well before the widespread adoption of refined sugar especially in the later half of the nineteenth century. In addition, the highest rate was recorded in the workhouse group. It is clear from socio-economic history, that these groups would have little or no access to any types of extrinsic sugars. Therefore, the high rates in the workhouse group in particular must be attributable to other causative factors than sugar consumption.

The link between caries and carbohydrates other than the classic sucrose has been extensively recognised in the osteoarchaeological literature (see Hillson 2000). High caries rates in populations with little to no exposure to sugar have been recorded in a number of skeletal samples. In a study of a late nineteenth/early twentieth Portugese sample of individuals from Coimbra it was found that 27.0% (2666/9562) of all teeth and 92.6% (476/514) of all individuals had caries (Wasterlain et al. 2009). This was attributed to the basic Portugese diet of potatoes, bread, fish, and dried vegetables. Exceptionally high rates were recorded in an Iron Age population from Alvastra in Sweden. A total of 46.2% (829/1794) of teeth, or 92.6% (88/95) of individuals, had carious lesions (Liebe-Harkort 2012). These very high rates were attributed to a diet of processed starch, including bread and porridge. Caries may be intimately linked with the consumption of refined and processed carbohydrates. 'Starchy food debris that remains in the mouth may…be broken down by an enzyme, amylase, present in the saliva. This yields sugars which the plaque bacteria are able to ferment' (Hillson 1986, 286). In the post-medieval period foods increasingly became more processed. For example, fine, processed bread was considered a sign of refinement in the nineteenth century and was highly desired (Mahon 1991). However, this would not have been the common food of the pauper.

The diets of paupers and the lower socio-economic classes in nineteenth century Ireland was very limited. It was dominated by the potato, which was typically supplemented with buttermilk in particular. Oatmeal and occasionally herrings were also consumed (Clarkson and Crawford 2001; Kennedy et al. 1999). The huge rate of potato consumption is mirrored in the reference to the 'potato people' (Clarkson and Crawford 2001, 30). By the 1840s the potato was the subsistence crop for at least one-third of the eight million inhabitants in Ireland (Crawford 1995, 60). It has been estimated the average adult male consumed approximately 12.5lbs of potatoes a day (Clarkson and Crawford 2001ff). High caries rates have previously been associated with high potato consumption (Wasterlain et al. 2009). These 'potato people' are precisely the people who were driven into the workhouses during, and immediately after, the Great Famine. It seems likely then that potatoes were being consumed in such enormous quantities by the poor that the caries prevalence was significantly heightened.

However, when the potato failed in Ireland due to the blight in the 1840s, the diet was supplemented with ground maize (Indian corn). The tougher whole maize grain had to be substantially processed prior to consumption, including being chopped in steel mills (Crawford 1995, 63-4). This processing, and the action of heating the starch, would ensure the grains were cariogenic. The maize had also been used in times of famine and/or food shortages since 1800 (Crawford 1995, 62). Increased caries rates have been noted in a number of studies relating to an increase in maize in the diet, and is associated with the high level of sucrose in the grain (Larsen et al. 1991; Larsen 1995). High caries rates had somewhat been anticipated in a study of nineteenth century migrant mine-workers in Kimberley in South Africa, not because of a high sugar intake but because of a diet high in machine-ground maize (Van der Merwe et al. 2010c). The actual low rates recorded (55.4% of individuals, or 5.4% of teeth) was attributed to the relatively young profile of the population and that, as migrants, many originated from a traditional agricultural diet, which was less cariogenic than the urban agricultural diet (ibid.). It is possible that some of the caries in the paupers of this study were as a result of the consumption of processed carbohydrates such as maize.

There were some other cariogenic sources, although access to them would have been severely limited in the poor. The Victorian period in particular was notorious for the adulteration of foods and other products. The Irish tobacco market in particular specifically preferred sugar added to tobacco (Mokyr and Ó Gráda 1988). Both smoking and chewing tobacco was a common practice. Certainly evidence of pipe-smoking has been identified in both the urban group (21.2% of observable individuals) and the workhouse group (20% of observable individuals) (Lynch 2002; Lynch 2004; Lynch 2008). Given the high rates of AMTL in the latter group it is likely that the prevalence of smoking is under-represented. If pipe-smoking was that common it is possible that chewing tobacco laden with sugar was also common, and may have been a contributing factor to the caries rates. Sugars were also used extensively in brewing. A recipe dating from 1602 lists 5/6 spoons of molasses to a gallon of whiskey, while sugar was also used in the brewing of poteen, and in homemade ales and wines (Mahon 1991, 28, 34, 37). However, the consumption of alcohol by the poor may have been somewhat limited by their very poverty (Clarkson and Crawford 2001), and in reality may have been of low significance in terms of cariogenic agents.

The prevalence of caries and ante-mortem tooth loss (AMTL) in the sexes was extensively examined. Numerous studies have observed variations in the prevalence of caries lesions between females and males, with higher prevalence rates frequently being recorded in females (Larsen et al. 1991; Saunders et al. 1997; Sutter 1995; Walker and Hewlett 1990). The differences between the frequency of the disease in females and males may be attributable to both physiological and behavioural factors (Larsen et al. 1991). The permanent teeth of females erupt earlier than males, thus exposing females to longer experiences of cariogenic foods. In addition, the traditional role of females as the food producer and as the primary child-carer, ensured that females generally had more frequent access to foods than males (ibid.; Larsen 1983). As noted above, frequency of snacking has been identified as an important factor in the development of caries (Gustafsson et al. 1953; Sheiham 2001). In contemporary hunter-gatherer societies it has been found that females tend to consume more carbohydrates while males tend to consume more protein (Larsen 1997; Walker and Erlandson 1986; Walker and Hewlett 1990). Hormones also appear to be highly influential in terms of caries, with females more susceptible to the development of caries in puberty, and during menstruation and pregnancy (Lukacs and Largaespada 2006). High caries prevalence rates in a Xavante Indian population in Brazil have been attributed to the fact that the females spend 90% of their productive lives either pregnant or breast-feeding (Arantes et al. 2009). However, although differences in prevalence between females and males are common, particularly with higher rates frequently being more common in females, it is not universal (Wasterlain et al. 2009). For example, in a study of nineteenth century female and male migrant mineworkers in Kimberley in South Africa there was no difference in the frequency of caries (Van der Merwe et al. 2010c).

Indeed, the findings of the present study initially did not appear universal across the groups. Males had a higher caries prevalence rate by individual in both the workhouse and the middleclass group, while more females were affected in the urban group. However, the differences were not statistically significant. When caries was considered in terms of prevalence by tooth, males had a higher prevalence in the middleclass group, while females had a higher prevalence in the urban group. Neither variation was significant however. In the workhouse group, female teeth (46.1%) had a significantly higher prevalence of caries over the male teeth (30.8%). However, it is the findings from the AMTL analysis that were more revealing. More female individuals were affected by AMTL than male individuals, but none of the differences were significant. When AMTL was considered by observable socket, again there were higher prevalence rates in females over males. However, all of those differences were significant. A significantly higher prevalence of female teeth had been lost ante-mortem than male teeth in both the workhouse (53.3% females, 40.3% males) and the urban group (24.3% females, 12.3% males), while the prevalence of AMTL in females in the middleclass group was almost three times higher in female teeth than in males (21.7% females, 7.3% males).

Given the high caries prevalence in all of these groups, it is likely that AMTL is closely linked with carious teeth in post-medieval Ireland. While AMTL may also be associated with gross attrition, periodontitis, and trauma (Lingström and Borrman 1999, 395), as well as extraction, when caries has a high prevalence, tooth loss may be very closely associated.

While the caries prevalence rates between the sexes in the three groups in this study varied, there were clear and significant biases towards AMTL in females in all groups. This suggests firstly that AMTL is somewhat masking the true caries prevalence in the populations. Secondly, it also indicates that there were significant differences in the oral health between the sexes, with females in all groups ultimately suffering more severely. The sexes were also examined individually across the groups in order to determine if there were any patterns in prevalence rates, both in terms of caries and ante-mortem tooth loss, within each sex. In both females and males, both in terms of the prevalence of caries and

AMTL by tooth/socket, there was a clear pattern. The rates were significantly higher in the workhouse individuals, the rates lowered in the urban group, and were lowest in the middleclass group.

Finally, the numbers of edentulous individuals is also an important factor to consider. Naturally, this presents its own problem in an archaeological context. The mandible may survive quite well in archaeological contexts, while the maxilla is frequently poorly preserved and incomplete (Waldron 1987). The posterior portions of the maxilla may often be broken off and lost in taphonomic processes. Thus all tooth positions may not always be observable. However, in most instances it was clearly evident that all of the teeth had been lost ante-mortem. No edentulous individuals were recorded in the middleclass group, 5% of the urban individuals had lost all of their observable teeth ante-mortem, while more than 15% of the workhouse population were edentulous individuals. The latter differences were statistically significant. It is likely, as noted earlier, that the high prevalence of AMTL, at least in the workhouse group, is related to the high caries prevalence. A similar relationship would exist in terms of edentulous individuals. Deliberate extraction may certainly have been a factor, but many teeth were probably loss directly as a result of caries: certainly when one considers that 46.8% of the teeth of the workhouse group had been lost ante-mortem and 37.4% of the surviving teeth were affected by caries.

By contrast, no edentulous individuals were present in the middleclass group, where just 12.7% of teeth had been lost ante-mortem and 13.5% of the surviving teeth were affected by caries. Indeed, the only instance of any visible dental work came from the Church of Ireland group from St John the Baptist church in Sligo, where a set of dentures were recovered from the maxilla of a female adult (Lynch 2001). In an unrelated site, a gold filling was recovered in the dentition of a 29 year old female from another Church of Ireland cemetery at St Mary's Cathedral in Limerick city (Lynch 2011), an indication of the options available to those with means. In reality the only factor that may arrest caries progress, apart from dietary change, is the application of fluoride, a factor which was certainly unknown prior to the twentieth century (Petersen and Lennon 2004). The only other deliberate dental intervention in terms of caries may be extraction. Certainly in the early twentieth century the practice of extracting the teeth in a pre-emptive strike against caries was common, at least in Britain (Roberts and Cox 2003, 324). The ante-mortem prevalence rate in the middleclass group suggests that this extreme, and often only available option, was not extensively employed. However, it may perhaps have been a deliberate policy in the workhouses in order to counteract the effects of decay.

Those who died in the workhouse generally would have lived lives of abject poverty before being finally forced into the workhouses. Individuals who died there were the most extreme cases. Their skeletal remains were intimately moulded by their life experiences, as were their dentitions. In most cases, paupers would have been born into poverty, ensuring that at least their teeth were compromised from the beginning. Infant mortality rates in Ireland, at least on the eve of the Great Famine, were high. It has been estimated that between 220 and 225 died out of every 1000 live births, with higher rates in urban areas and in Munster and Connaught (Mokyr and Ó Gráda 1984, 484). Infant mortality in Western Europe at the time was between 150-160 per 1000 (ibid.). A study of caries lesions in school children in London found that those who had health problems in the neonatal phase were more susceptible to caries lesions in later life (Brook et al. 1997, 216). It may be expected that health problems experienced by neonates would have been substantially more widespread in nineteenth century Ireland. In addition, chronic malnutrition linked with stunted growth has also been linked with increased rates of carious lesions (Alvarez et al. 1988; Floyd 2009).

Evidence of statures have already been examined in **Chapter 5**, with clear indications of diminished height for those in the workhouses. The next chapter will examine the evidence of infection in the study groups.

CHAPTER 7:
Non-specific Infection

7.1 Introduction

Infectious disease is as ancient as any biological entity in the world. Evidence of infection has recently been found in fossilised reptilian remains that are 275 million years old (Reisz et al. 2011) and, not surprisingly, it continues to be an integral part of all biological systems today. Levels may vary from a minor to a major infection. A cut to the tip of a finger may result in a minor infection manifesting as a slight swelling and soreness of the fingertip, which may heal itself in a matter of days. In contrast, diseases such as leprosy conjure up visions of medieval horror to those in the modern Western world, but remain a reality for many in more impoverished nations. The types of infections that have affected humans have varied, both in form and severity, through time and across space. Some major infectious diseases, such as bubonic plague, that in the past claimed millions of lives, have significantly diminished through the centuries as a result a variety of factors. Other infectious viruses, such as the human immunodeficiency virus or HIV, have reached pandemic proportions in a relatively short length of time. Crucially, infectious diseases are ever-evolving, both in terms of the specific diseases (either diminishing or decreasing in severity) and in terms of the development of new diseases (Colwell 1996; Hutchinson 2001). Today, despite the enormous advances in medicine, infectious diseases are not decreasing in global terms. They are simply changing (Singh and Singh 2008).

The ability of humans to begin to deal with infections has only been a very recent development. In reality, prior to the advent of modern Western medicine, there was little that could be done about any form of infection in past populations. There was a fundamental misunderstanding of how most diseases were spread, and cures were largely limited to natural remedies and folklore or magic (Robins 1995). Treatment and cures were largely trial and error, and little could really be done to alleviate the actual suffering of individuals (Malcolm and Jones 1999, 132). Preventative medicine was an unknown concept. Naturally some fortuitous events occurred: the lack of non-specific infection in Roman-era skeletons from Herculaneum in Italy, was linked with the consumption of dried fruits that were contaminated with a bacterium that produces natural tetracycline, an antibiotic (Capasso 2007). Similar evidence regarding tetracycline was previously identified in a prehistoric agricultural population from a Nubian site (Armelagos et al. 1981; referenced in Larsen 1997, 90)

It was not until late in the nineteenth century that modern medicine truly began to be developed and that crucial preventative, rather than reactive, measures could begin to be put in place. This was combined with an increasing sense of social responsibility among governments. For example the initial relentless work by Edward Jenner against smallpox at the end of the eighteenth century finally ensured the eradication of the disease in the late twentieth century through a structured global response (Riedel 2005). It was through the pioneering work of Louis Pasteur and the ground-breaking discoveries of Robert Koch, amongst others, in the latter part of the nineteenth century, that the onslaught of infectious diseases began to be addressed seriously, particularly in the wealthier nations.

However, even with modern medicine today many elements may prevent the effective curing and/or prevention of a number of diseases, perhaps most noticeably AIDS in the African continent (Schneider et al. 2006). While the chronic non-communicable 'diseases of civilisation', such as heart disease, have taken hold in the Developed World, infectious diseases remain as the primary killers in the Third World (Eaton and Eaton 1999; WHO 2011). Today alone, malaria is estimated to be responsible for one million deaths worldwide annually (Saker et al. 2004, 32), while tuberculosis is making a global reappearance (Roberts and Buikstra 2003). In terms of the present study, infectious diseases were the greatest killers in post-medieval Ireland, hence the importance of their assessment. It is unfortunate then that most infectious diseases leave either no trace on the human skeleton or the skeletal lesions cannot be isolated to a single aetiological disease.

This chapter will examine the basic elements involved in the infectious process (**Section 7.2**). An overview of the pantheon of the main infections that may affect humans will be presented, with a particular reference to post-medieval Ireland (**Section 7.3**). The skeletal manifestations of infection will also be examined (**Section 7.4**), and an overview of some recent osteoarchaeological studies of infection will be presented (**Section 7.5**). The expectations for the present study are provided in **Section 7.6**, while the methodology employed has already been detailed in **Section 4.2.4**. The results of the analysis are provided in **Section 7.7**, and finally the results are discussed in context in **Section 7.8**.

7.2 The Basics of Infection

An infection enters the body's system via a micro-organism. Perhaps somewhat ironically, this element, which is responsible for probably more deaths in human history than any other factor, is invisible to the naked eye. This was partly the reason why it took humans so long to begin to combat these diseases (**Section 7.3**). Until the late nineteenth century disease was believed to spread primarily through bad noxious air, or the 'miasma' (Robins 1995). It was only in the latter half of that century that the germ theory became accepted as the causative factor in disease, and in reality it was only by 1900 that the acceptance was widespread (Farmar 2004).

The harmful micro-organisms (or microbes) that cause infection are called pathogens. These are divided into three broad groups: bacteria; viruses; and rickettsiae (essentially a variation of the former two). Most of the great infections are/were caused by bacterial and viral infections. Bacterial and viral infections are fundamentally different. Bacterial microorganisms live in the body but do not penetrate the cells of the body. They replicate themselves by subdividing. In contrast, viral infections invade the actual cells of the body, from which they then produce new viral cells.

Pathogens may be airborne, they may be directly passed through bodily fluids, or they may be passed through contaminated food or water. All involve actual human contact, in some form, from the infected to the non-infected. In reality epidemics are a hallmark of civilisation. They simply could not, and cannot, thrive without an adequate population base (Mitchell 2003a, 175). In the individual, the infection may be acute and localised, or chronic and systemic (Goodman et al. 1984, 33). Acute infections, by their very nature, will typically not manifest on the bone. This is primarily due to the person either recovering or succumbing quickly to the disease. In contrast, chronic systemic infections, with which one may survive for some time, may eventually transfer to the bone. Classically, the bone reaction will manifest in one of three ways. In order of increasing severity these are periostitis, osteitis, and osteomyelitis. Periostitis is the manifestation most frequently seen in archaeological skeletons (see **Section 7.4**).

The spread and severity of an infectious disease is dependant on numerous factors. However, the transmission of these communicable diseases lies in that very term, 'communicable'. Infectious disease requires a host individual in order to pass from one individual to another. The basic human need for contact ensures that these diseases thrive in human societies, particularly as populations increase and groups come into closer contact with each other, both locally and particularly globally. Urbanisation, with its inherent problems of overcrowding and sanitation, particularly in the founding phases, accelerated the spread of disease (Lewis 2002). As Western Europe began its major global spread in the Early Modern period, so the diseases of the Old World spread to the New, often with the result of the utter decimation of the native populations (Cook 1998; Warrick 2003).

Invariably, given the fact that human contact is necessary for the transmission of infections, both population size and movement has been intimately linked with the diffusion of disease. Epidemic disease could only come about when population levels were adequate enough to sustain them (Mitchell 2003a). A study of an outbreak of plague in France in the 1720s found that 88% of villages of less than 100 people were spared the disease. In contrast, population concentrations of more than 1000 people were greatly affected (Biraben 1968; quoted in Strassmann and Dunbar 1999, 95). Population movement was, and is, also crucial to the spread of disease. Migrations may range from classic urbanisation to displacement by war to colonisation. Fever, typhus and dysentery were the 'three great afflictions' to the armies of the medieval crusades (Cook 2001, 95), and they certainly accompanied the armies that swept through the Ireland in the war-filled sixteenth and seventeenth centuries. Typhus and dysentery were 'twin companions' for many armies (Robins 1995, 22) and may be responsible for more deaths that warfare ever was (Raoult et al. 2006; Cook 2001). It is surmised that disease killed eight times more men that combat during the Napoleonic Wars (1803-1815) (Cook 2001, 95). In urban contexts, variations in disease in specific age-at-death groups may be linked with immigrants coming in to the city in comparison to native-born inhabitants, who have grown up in its environs, and the different susceptibility of these groups to disease (Landers 1987).

Social and cultural factors play a considerable role in the transfer of infectious diseases. In an affluent Western society, with good levels of sanitation and medical care, it may be expected that infectious diseases would be a relatively rare occurrence. Of course this may be disrupted, for example, by a breakdown in the normal barriers of society. An impoverished society, with individuals living in squalid conditions and with inadequate access to medical care, may be more susceptible to disease, as well as to its transmission. However, this is not universal. During the Great Famine in Ireland, staff in workhouses, along with doctors and the clergy tending to the sick, had a very high mortality rate, presumably due to the virulence of the infections and the lack of previous exposure of these individuals to infectious diseases (O'Connor 1995; Ó Gráda 2006a, 203). Western visitors may be horrified by the filth in the rivers of the Nepalese and Indian cities today, but the locals have essentially built up a certain level of immunity to the infections that may pervade such areas (Eshed et al. 2010). Also, one individual's susceptibility to a disease may be different to another person, and crucially some people will be naturally immune (Mitchell 2003a).

There are a wide variety of factors, both intrinsic and extrinsic, that determine whether a person succumbs to a disease process or not, and to what degree they are affected (Roberts 2000b, 146). These include 'pathogenicity of the agent, route of transmission, nature and strength of host response, age, sex, genetic predisposition, nutritional status, occupation, trade and contact, climate, population density, economy, sanitation, quality of housing, etc' (Roberts 2000b, 146). The cyclical play between poverty and disease is undeniable (Taylor 1983). Poor hygiene is virtually a constant companion of poverty and that specifically can particularly promote the spread of disease (Talavera and Pérez 2009). In post-medieval Ireland, the development of a very large poor class, often in crowded and unhygienic living and working conditions, ensured that infectious diseases played a very significant role in the lives of many people.

Studies have shown that levels of infection increase when a population is under stress. In the Americas, an increase both in frequency and severity of infection have been recorded in skeletons where there was a known population rise and/or decreases in mobility, and also with an increase in reliance on maize (Larsen 1997; Cohen and Armelagos 1984). Crucially, there is a synergistic relationship between infection and nutrition in particular (Larsen 1997, 88), although a clear-cut connection has been somewhat disputed by some (Appleby 2000). Either one can directly affect the other. If a person is suffering from an infection, then their ability to absorb the necessary nutrients may be seriously compromised. That is, of course, if they are receiving adequate nutrition to begin with. Conversely, if a person is undernourished, or indeed malnourished, they may be more susceptible to contracting an infectious disease. At the very least, a reduction in food intake may be associated with other factors such as a decline in living conditions, which in turn may exacerbate the normal levels of exposure. Clearly, a ravaging cycle may develop between poor nutrition and infection (Macallan 2009). 'Often one pathophysiological state will predispose an individual to one or several other diseases' (Goodman et al. 1984, 33). Poverty in particular, and the often associated factors such as poor hygiene and lack of education, may ensure that an individual, or indeed a whole section of society may consistently be under physiological stress.

Interestingly also, variations have also registered in prevalances of infection between females and males. The lesions are typically higher in males in a population (for example, see Adams and Colls 2007; Brickley et al. 2006; Miles et al. 2008; Shuler 2011), although higher prevalences have also been recorded in some females (Larsen 1997, 92). In general, the growing male appears to be more susceptible to being affected by stress than the growing female (Goodman et al. 1984). Higher prevalence rates of infection in males have also recently been found in the European module of the Global History of Health Project (Global History of Health Project 2009). Interestingly, records show that males typically have higher mortality rates than females in both historical and modern famines, including the Great Famine of the mid-nineteenth century in Ireland (Mokyr and Ó Gráda 1999). This suggests that males physically are more at risk in times of stress, and that it ultimately can affect life expectancy. It is likely that the variation in females and males in terms of experiences of physiological stress is due to a combination of factors. For example, males are generally physically larger and demand higher calorific intake than women. In times of food shortages males may begin to suffer from poor food intake more quickly that females. In addition, differential occupational hazards may expose females and males to difference living and working experiences and also then to infectious experiences. Essentially however, prevalence rates are uniquely influenced by individual circumstances (Larsen 1997, 91ff).

Until the nineteenth century, there were two basic theories as to how disease spread: the miasma theory, which taught that disease spread through noxious vapours; and the contagion or germ theory, which held that transmission was through contact with an infected person (Robins 1995, 131; Malcolm and Jones 1999). The first theory held fast for millennia, and medical advances were largely minimal while the miasma theory was espoused. The germ theory was suggested as early as 1840 by Friedrich Henle, although it was Louis Pasteur that finally recognised the true potential (Mackintosh 1955). Robert Koch, the renowned German physician, ultimately developed Pasteur's theory in the latter part of the nineteenth century when, amongst other achievements, he identified the causative agents of anthrax, tuberculosis, and cholera (Malcolm and Jones 1999, 131). Even then, it took many decades for modern pathogen science to develop (Farmar 2004).

The learning curve was sharp. Christian religious beliefs played a significant role in the manner in which scientific discoveries were interpreted by the masses. The nineteenth century in particular saw nothing sort of an intellectual battle between science and religion (Moore 1988; Olson 2006; Wohl 1983). It is perhaps difficult now to understand what a phenomenal asking it was for many people to believe in the existence of germs. For a considerable period of history in Europe, disease was viewed as a direct infliction on the human race by God, as a test of faith or as a punishment for sins (Rawcliffe 1995, 84). An excerpt from the pastoral letter of Bishop Murray to the Roman Catholic clergy in Dublin, during the cholera epidemic of 1832-1834, reads as follows: 'you have disregarded the warnings of the word of God… Your sins have ascended to the throne of the Lord, and demanded justice…' (Murray 1832, 434). Even when science had proved its worth in the battle against disease there were still other obstacles to overcome. Just one poignant example is that of 'Typhoid Mary' or Mary Mallon. She was an Irish cook in New York in the early twentieth century, who was a carrier of typhoid fever. Despite attempts by the authorities to get her to cease her occupation, she spread the disease to at least 51 people, three of whom died. With no understanding of how to deal with her, she was finally kept in forced isolation for 26 years, and died in 1938 (Brooks 1996, 191; Aufderheide and Rodríguez-Martín 1998).

7.3 The Human Experience of Infection

From the first moment of life, whenever one may surmise that it begins, a human being is susceptible to infection. In the womb, a foetus is naturally intimately linked with the mother and her health status. Numerous infections may be passed from the mother to the developing infant (maternally acquired infections), such as rubella, chickenpox, and syphilis. During birth the risks of infection to the infant, both from the mother and from immediate external elements, are very high and the susceptibility of the young infant to infection remains high. This physical vulnerability derives from the immature immune system, and is combined with a high energy and nutrient requirement relative to body weight (Rousham and Humphrey 2002). In the past, and still in developing countries, infectious diseases were the major cause of death in infants up to one year old. After that age, problems associated with malnutrition become a primary cause of death in young children (Higgins 1989, 185; Kaler 2008). When poor nutrition is combined with poverty the results may be particularly devastating in terms of infectious disease (Kaler 2008). An infant has only a very limited ability to produce antibodies until about the third or fourth month (Johnston 1994). Diptheria, measles, poliomyelitis, and whooping cough can also claim a high death toll in the infant age group (Macpherson 1992; Frazier et al. 1996). Vaccinations have undoubtedly resulted in the reduction and/or the eradication of many childhood infections and have saved countless lives, particularly with regards to measles, mumps, and rubella (Frazier et al. 1996). However, the vaccinations are only effective if firstly, the disease is a suitable candidate (such as smallpox was (Geddes 2006), see **Section 7.3.1**), secondly, if there is an orchestrated government policy, and thirdly, if parents participate in the vaccinations. However, even the best of intentions may be thwarted. In the late 1990s a hypothesised link between the MMR vaccine (against measles, mumps, and rubella) and autism led to a genuine public fear, leading to a significant drop in the levels of vaccination against these serious diseases (Burgess et al. 2006).

Prior to very modern milk formulas, no post-weaning diet could ever begin to contend with the benefits of breastmilk and still today 'breast is best' for newborns. In addition, the utensils used to feed infants could literally have been life-threatening. Indian-rubber teats began to be manufactured in the 1850s, but most of the poor that did artificially feed their infants milk still used rags (Wohl 1983, 22). The risk of infection from both was high. The passage from breast-feeding to solid foods is also a hazardous time for an infant, particularly so in the past. The child must be physically able to consume a solid diet and that diet must be suitable for an infant. Failures in either, or both, can lead to serious nutritional problems, which in turn can make an individual more susceptible to infection. In any case, there was no such thing as 'baby-food'. Children were weaned onto adult diets (Wohl 1983, 20). Adulteration of foodstuffs was a real problem, and was certainly a cause of death in infants being weaned (Hardy 2000). In addition however, the weaned child may be exposed to a whole new series of pathogens, primarily through unhygienic practices (Scott 1999, 32; Brennan et al. 2004; Smith and Harvey 2010). Foods and utensils may not be sterile and the previously exclusively breastfed infant may be high risk. As mentioned, prior to the late nineteenth century, people had no concept of germs lurking on surfaces. Diarrhoea is intimately linked with poor hygiene and is a detrimental disease in Third World countries today. Diarrhoeal disease is the second leading cause of death in children under the age of five years and an estimated 1.5 million children die each year (WHO 2009). As industrialisation took hold, in the eighteenth and especially the nineteenth century, weaning ages typically declined. This had a significant impact on the health profile of growing children, particularly in the large Victorian cities in Britain (Lewis 2002; Mata 1985).

The correct feeding and protection of an infant in its first months and years are conducive to longevity and overall health, while early malnutrition is linked with a higher probability of growth retardation (Brennan et al. 2004; Lechtig 1985). If the society in which the child grows into has its own inherent problems, not only regarding disease loads, but also compromised living and working conditions, then any advantage a child may have gained from its mother's milk will not be enough. There can be little doubt that infections were serious problems for children in the past (Roberts and Manchester 1995, 124), and remain so for children in Third World countries today (Rodríguez et al. 2011).

After the primary childhood infections the diversity of infections that people could have been exposed to in the past may be somewhat overwhelming for the modern observer to comprehend. Mention has already been made of the great medieval Black Death, the plague that decimated Europe in the fourteenth century, and sporadically continued in Ireland until the latter part of the seventeenth century (Benedictow 2006; Kelly 2001). Yet this was only one of a series of devastating infectious diseases that ravaged populations as modernity developed. Other prominent epidemic killers included, amongst others, smallpox, typhus, influenza, poliomyelitis, and tuberculosis (Appleby 2000, 25; Roberts and Cox 2003, 32; Geary 1996a, 27). The Spanish influenza pandemic that swept the world in 1918-19 killed between 14-50 million people and infected half of the world's population (Reid et al. 2001; Taubenberger and Morens 2006). As with many infections, class was no barrier.

Table 7.1 provides an insight into just some of the more common infections that can and have affected humans. There is no doubt that these diseases, amongst other infections, have been the greatest killers of humans over time. **Section 7.3.1** will examine some of the main infections that were common in Ireland in the post-medieval period.

Table 7.1.
Selected list of common infections in humans (Mitchell 2003a, 172, Table 1)

Disease	Infectious Agent	Principle mode(s) of transmission
Cholera	Bacterium	Contaminated food/water
Diphtheria	Bacterium	Contaminated food/water
Hepatitis A	Virus	Contaminated food/water
Hookworm	Parasitic worm	Contaminated food/water
Salmonella	Bacterium	Contaminated food/water
Tapeworm	Parasitic worm	Contaminated food (undercooked pork)
Typhoid	Bacterium	Contaminated food/water
Chicken pox	Virus	Droplet
Common cold	Virus	Droplet
Influenza	Virus	Droplet
Measles	Virus	Droplet
Mumps	Virus	Droplet
Poliomyelitis	Virus	Droplet
Rubella	Virus	Droplet
Scarlet fever	Bacterium	Droplet
Smallpox	Virus	Droplet
Tuberculosis	Bacterium	Droplet
Whooping cough	Virus	Droplet
HIV/AIDS	Virus	Sexual contact; blood
Syphilis, yaws	Trepenomal bacteria	Sexual contact; lesion to lesion contact
Plague	Bacterium	Flea and rat vectors; droplet
Typhus	Rickettsia	Flea and rodent vectors
Encephalitis	Virus	Insect vector
Malaria	Amoeba	Insect vector
Onchocerciasis (river blindness)	Parasitic worm	Insect vector
Trypanosomiasis (sleeping sickness)	Protozoan	Insect vector
Yellow fever	Virus	Insect vector
Schistosomiasis (bilharzia)	Parasitic worm	Snail vector

7.3.1 Infectious Disease in Post-medieval Ireland

It is difficult to assess specific causes of death prior to the twentieth century. Compulsory notifications of death did not begin in Ireland until 1864 (Crawford 2003; Geary 1997, 108). Indeed, it was only with the advent of formal government censuses (the first being completed in 1821) that causes of death began to be addressed seriously. The lack of records of deaths for Dublin was highlighted by Dr William Stoker in 1835, when he lamented the fact that disease could never be combated while there were no records as to the causes-of-death (Stoker 1835). Dr William Wilde was largely responsible for the compilation of data on morbidity and mortality in the Irish census of the nineteenth century (Crawford 2003). The 1851 census listed just over 100 diseases (ibid., 72). Wilde ensured that data on diseases were backtracked as far as the 1830s. However, the census records cannot provide very detailed and reliable data as they were a product of their age. For example, Wilde merged data on mortality from cholera with some cases of dysentery and diarrhoea (Geary 1997, 109). Problems like this, with nineteenth century records, are widespread. In England, typhus and typhoid were combined in the Registrar Generals statistics until 1869 (Woods and Hinde 2000). Fevers, in particular, were poorly understood. The general term 'fever' could cover a multitude of diseases. Pre-nineteenth century Bills of Mortality in London list no less than 35 different fevers (Dobson 1997, 237). Even when the records existed, there are terms which do not make sense to the modern reader. The Bills of Mortality for London in the seventeenth and eighteenth centuries list causes-of-death that include 'quinsy', planet-struck', and 'imposthume' (Dobson 1997). Part of the problem of using these records is that in many instances, the cause is actually the symptom/s, or perhaps some unrelated physical affliction that was not the actual cause-of-death. Therefore there are causes-of-death which include 'flatulence', 'hiccups', 'nose bleed', and even 'poverty' (ibid.).

However, modern research has identified a number of primary infectious diseases that were very common in both Britain and Ireland in the post-medieval period. Disease in nineteenth century Ireland were characterised by the 'epidemic triumvirate' of fever, dysentery, and smallpox (Geary 1995, 77). All are examined here, along with one of the other most devastating and debilitating diseases of the day, cholera. Other diseases, which appeared with a vengeance in times of stress and social upheaval, such as pellagra and xerophthalmia (Ó Gráda 2006b, 203), are not discussed here as these relate to vitamin deficiencies in the diet. They are discussed in **Section 3.4.2**. However, scurvy (vitamin C deficiency) will be addressed in **Section 7.3.2** below, (for reasons explained in that section). The descriptions of infectious disease below are in no way exhaustive, and there were certainly other significant infectious diseases in the post-medieval period. These however are the primary ones.

'Fever' was a constant feature of the nineteenth century in particular. Its frequency and severity is intimately linked with shifts in population, which may be associated both with economic recession and economic expansion. Almost one-third of deaths (29.2%) during the Great Famine have been attributed to it (Ó Gráda 2012b, 173). The famous 'fever' of nineteenth century Ireland is now known to actually be two different primary infections: typhus fever and relapsing fever (Geary 2012, 199). The two are remarkably similar. 'Both are caused by microorganisms transmitted by the human body louse' (Geary 1995, 75). The spread of typhus fever is facilitated by overcrowding and poor sanitation. The micro-organisms multiply in the intestines of the louse to such an extent that it defecates frequently until it dies. The host person will scratch where the louse is feeding and defecating, and the infected matter is transferred into the human host. It may also be contracted through the conjunctiva of the eyes, or through inhalation (Geary 1995, 75). After an incubation period of one to two weeks a fever and headache will develop. A skin rash develops and the liver and spleen will enlarge, and delirium ensues (Aufderheide and Rodríguez-Martín 1998, 246; Berkow and Fletcher 1992, 172; Geary 1995, 75; Oliver et al. 1996). Although mortality is low in children less than 10 years of age, the rates increase with age, up to perhaps 60% in those aged over 50 years (Berkow and Fletcher 1992, 172). It averages at 10% mortality (Aufderheide and Rodríguez-Martín 1998). The disease is particularly associated with poor living conditions. There were serious outbreaks of typhus in Ireland between 1800 and 1832, with the worst occurring between 1816-1819 (Robins 1995, 32). It was not until 1911 that the mode of transmission of typhus was finally described (Cartwright and Biddiss 2000, 85). The Irish were frequently associated with spreading this disease, particularly in the nineteenth century. When typhus was reported in New York City in 1847 it was directly associated with Irish immigrants (Gelston and Jones 1977). Typhus was known by a variety of names such as famine fever, gaol (jail) fever, camp fever, spotted fever, and putrid fever, as well as being called the Irish fever or ague, until the term typhus began to be used in the mid-eighteenth century (Geary 2004, 71; Wohl 1983, 125).

Relapsing fever is remarkably similar to typhus and both are spread by the human body louse, hence the confusion. Relapsing fever is transmitted through microorganisms entering the body when an infected louse is crushed on the skin and the skin is then scratched (Oliver et al. 1996). The transmission may be particularly rampant in areas of high population density with poor hygiene. A person may suffer as many as six relapses, and there is a mortality rate of between 5-40% (Oliver et al. 1996, 50). It presents typically between 3-7 days after infection with high fever, chills, headache, muscle-pain and weakness, which may last six days. A rash may develop as the initial symptoms ease. Anywhere between 7-60 days later a relapse may occur, with each relapse being gradually less severe than the last. In fatal cases, death is typically caused by either heart or liver failure, or a brain haemorrhage.

Typhus fever and relapsing fever were referred to as 'famine fever', 'starvation fever', 'the fever', 'relapse fever of 1847', 'five days' fever', and 'road fever' during the Great Famine (Geary 1995, 83). Many of the names are a reflection of the manner in which the diseases typically spread by the wandering destitute and often transmitted to those attempting to help. Certain fevers tended to occur in certain classes and have different mortality rates. Relapsing fever was common among the poor, while typhus tended to affect those in the higher classes, invariably with higher mortality rates in the latter also (Geary 1995, 83; Geary 2012, 199). In reality, infectious diseases knew no bounds in the pre-antibiotic era. The poor, being so frequently exposed to disease through repeated stresses, may have built up a certain level of immunity. However, any advantage of immunity was likely highly compromised during the Great Famine with the severely limited nutrition and the effects of destitution. It is unlikely that the middle and upper classes had built up any immunity to fevers in particular, and many fell victim to the various fevers, as stated particularly to typhus fever. Mortality rates were especially high in those individuals attempting to relieve suffering, namely medical staff and the clergy (Ó Gráda 2006a, 203). In the Catholic diocese of Cloyne and Ross in Cork, 17 priests died by the end of 1847 as a result of their involvement with the poor (Ó Gráda 2012b, 172). While the mortality rates of fever were typically lower in the poor, there were side-effects that could be devastating. Relapsing fever was common in the poor, but typically not with high mortality rates, at least before the Great Famine. However, due to its recurring nature, a family, particularly if the primary bread-winner was struck down, could be afflicted with the disease for months. That was the catalyst that could push a family that was surviving right over the edge into utter destitution (Geary 1995). The pattern, once established, was cyclical and devastating. Those who are suffering under/malnourishment are more susceptible to disease, which in turn makes them even weaker. In desperation people move in search of relief, which both destroys the existing social order and causes severe problems further afield as the unfortunates crowded into cities.

Dysentery, diarrhoea, and gastroenteritis were also very common during the Great Famine, and almost a quarter of deaths (24.9%) have been attributed to these disorders (Ó Gráda 2012b, 173). These are common in most famine crises, even today, particularly when access to basic medication is limited or absent (Ó Gráda 2009, 115). Dysentery occurs in the lower intestine, in comparison to diarrhoea which occurs further up in the intestinal tract. Diarrhoea comprises mainly watery emissions and the main associated problem is dehydration. The occurrence of dysentery in the lower intestine allows the development of the characteristic bloody stools, which gave the disease the label the 'bloody flux' (Berkow and Fletcher 1992; Bouckenooghe and DuPont 2004; Geary 1995). The spread of dysentery, as with many infectious diseases, is facilitated by overcrowding and poor sanitation. The dysentery bacillus is spread by flies, by direct contact, or by the contamination of water by infected faeces. The disease may be mild or very acute, and can last up to a fortnight. Mortality rates of up to 50% are known during epidemics (Geary 1995). It remains a serious problem today in impoverished societies (Kelly-Hope et al. 2008; Chen et al. 2006). Prior to the advent of modern hygiene practices and general public health improvement the disease could ravage a population. It could take a death-grip on a population especially in times of social upheaval. The disease, popularly known as 'the disorder', was common in Ireland during Great Famine (Geary 1995; Geary 1997). The 'starvation dysentery' took hold when, as the potato declined in the diet, people substituted inadequate foodstuffs, including foraged foods and poorly cooked Indian meal (ibid. 107). The bloody nature of the stools makes the disease relatively easily identifiable, and there are contemporary accounts of dysentery from the nineteenth century. Dr Daniel Donovan of Skibbereen in County Cork provided a particularly harrowing account of chronic dysentery during the Great Famine:

> ' …the pulse was almost entirely absent, …the extremities were livid and cold, the face haggard and ghost-like, the voice barely audible and reminiscent of the cholera whine. Anasacra [*swelling*] of the feet, legs, scrotum and penis developed and very often sloughing [*peeling*] of the mouth, tongue, throat and nostrils. The smell from evacuations was very offensive, almost intolerable, and was similar to that of "putrid flesh in hot weather". The discharges continued unabated until the body wasted to a skeleton. The patient, although extremely debilitated, retained his faculties to the last and expired without a struggle' (Geary 1995, 84).

Smallpox has been virtually eliminated from the modern mindset, yet it was a particularly destructive infectious disease in the past, claiming the lives of millions through the millennia, until it was finally declared eradicated in 1979 by the World Health Organisation (WHO 2001). While infections such as dysentery were intimately linked with inadequate nutrition, smallpox was 'so virulent that it act[ed] independently of nutrition' (Geary 1997, 107). The term 'smallpox' distinguished the disease from the 'great pox', or syphilis. It is believed to have originated in northeastern Africa and its global progress closely followed patterns of human urbanisation and colonisation. By the medieval period it had reached epidemic proportions in Europe, from where it spread to the New World. The disease is spread by the variola virus. It is characterised by the development of small, fluid-filled or vesicular lesions on the skin. The disease may be transmitted before the rash develops through nasal secretions in particular, which can become airborne through sneezing. The skin lesions are also infectious. The severe clinical variola major form of the disease is highly fatal with 30% mortality, and involves pulmonary oedema secondary to heart failure. The variola minor is less severe and may be misdiagnosed as chickenpox. Survivors were inevitably left with scarring. In Europe it was initially combated in the eighteenth century by inoculation or variolation, whereby an individual was essentially deliberately infected with the variola major virus. The death rate could be as low as 2% and the survivors were then immune to the virus. It was in the latter part of that century that Edward Jenner (1749-1823) developed a vaccine against smallpox using cowpox. The Latin root word for cow is *vacca*, hence the coining of the term vaccination. Although Jenner was not the first to use the technique, he was the one responsible for its global spread (Aufderheide and Rodríguez-Martín 1998; Gani and Leach 2001; Geddes 2006; Lofquist et al. 2003; Riedel 2005; Stewart and Devlin 2006). Despite the use of vaccination, by the early 1950s there were still an estimated 50 million cases of smallpox in the world annually (WHO 2001). In the 1960s the World Health Organisation embarked on a global campaign of vaccination, leading to its complete eradication by the late 1970s (ibid.). In Ireland, compulsory vaccination began in 1863 (Brunton 1999). The last death from smallpox in Ireland was in 1907 and general vaccination against it ceased in 1972 (Houghton and Kelleher 2002). The virus is still maintained in two laboratories and has been recognised as a significant threat in terms of biological warfare (Parrino and Graham 2006).

One other disease had a particularly strong toll in post-medieval Ireland. This was cholera, often referred to as 'King Cholera' due to its dominance (Longmate 1966). It is a virulent disease, spread by drinking water that is contaminated with infected faeces, or by eating contaminated food. Cholera may make an appearance when sanitation is compromised or indeed non-existent. Although it is of great antiquity, the disease reached pandemic proportions in the nineteenth century. Ireland was particularly devastated by outbreaks of the disease in 1832-34 and also during the Great Famine (Robins 1995). As with many other diseases it could never be defeated, or at least effectively combated, until the contagion theory was accepted. During a cholera outbreak in London in 1854-55, the theory of germ transmission was famously put to the test by Dr John Snow. He believed the disease was water-borne and he linked the concentrated outbreak to one particular water-pump on Broad Street. In order to prove his theory he removed the handle from the pump, the so-called 'Grand Experiment', and the levels of infection in the surrounding area waned (Hill 1955). Snow himself admitted that the deaths were in the decline *before* his action, and modern observers suggest his study was flawed, but non-the-less the point was proven (Hill 1955; Mackintosh 1955).

Clearly hygiene and living conditions played a crucial role in the transmission of infectious diseases in post-medieval Ireland, as they still do today in many impoverished communities. In the post-medieval period in Ireland, as conditions largely worsened for a significant portion of the population (see **Section 3.3**), so the disease load increased. The significant rise in food poverty, particularly into the nineteenth century that culminated with the Great Famine of the 1840s and 1850s, raised the susceptibility of individuals to disease. In addition, the decline in living conditions, both in the crowded urban cities and the squalid rural one-roomed huts, ensured that even the basics of shelter, food, and clothing were compromised for many. Crucially, what is most important, and frustrating, in terms of osteoarchaeology, is that although these diseases claimed countless lives through the centuries, they leave no diagnostic lesions on the bones of the dead.

7.3.2 Dietary Deficiencies

While periosteal lesions are typically linked with both specific and non-specific infections (see **Sections 7.4** and 7**.5**), they may also be associated with a particular dietary deficiency. A number of osteoarchaeological studies have linked certain aspects of periosteal bone lesions with vitamin C deficiency, or scurvy. The abounding physical manifestation of vitamin C deficiency is haemorrhaging, either spontaneously or following minor trauma (Ortner 2003, 383-6). There are subcutaneous (under the skin) haemorrhages, the limbs will be swollen, and the gums very characteristically will become swollen, soft, and spongy, with frequent bleeding. The body becomes highly sensitive to touch and even the slightest knock can result in considerable pain and bleeding (Clarkson and Crawford 2001, 146). It is this defining trait of haemorrhaging that links scurvy in skeletal remains with that of periosteal lesions as discussed in this chapter. The bleeding specifically can allow the growth of periosteal bone on the limbs, around the joints, and in the bones that support the muscles for chewing.

Scurvy first became recognised following the long sea-voyages of the sixteenth century (Maat 2004). Although the consumption of oranges as a preventative measure had been lauded from as early as the middle of the sixteenth century, it was not until 1747 and the work of Scottish physician James Lind, that the importance of citrus fruits in combating vitamin C deficiency was finally accepted (ibid.). Scurvy is not a disease of the past. It still occurs today, from malnourished individuals including both adult and children (De Luna et al. 2003; Larralde et al. 2007; Narchi and Thomas 2000; Tamura et al. 2000), to poor humanitarian provisions (Ahmad 2002; Institute of Medicine 1997).

Scurvy was not a significant issue in Ireland when the potato was the mainstay of the majority of the Irish population up until the mid-nineteenth century (Clarkson and Crawford 2001, 146ff). The nutritious potato is rich in vitamin C (Maat 2004, 78; Dickson 1997, 12). It has been estimated the average adult male consumed approximately 12.5lbs of potatoes a day, which would certainly act against any level of vitamin C deficiency (Clarkson and Crawford 2001, 63ff). By the 1840s the potato was the subsistence food for about one-third of the Irish population, and played a major role in the diets of many more (Crawford 1995, 60; Ó Tuathaigh 1990, 203; Póirtéir 1995b, 9). However, when the Great Famine occurred, and the potato was essentially removed from the diet, scurvy quickly became a major issue (Clarkson and Crawford 2001). Individuals that are used to high levels of vitamin C will suffer more quickly when there is reduction in the same than an individual who may have been getting normal levels of the vitamin. In addition, infections, which became very prevalent in that period (see **Section 7.3.1**), can reduce the absorption of vitamin C (Clarkson and Crawford 2001, 148).

In terms of osteoarchaeological studies, evidence of scurvy has been identified in a number of populations where it is assumed individuals would have had a decreased access to vitamin C. A study was recently undertaken on the well-preserved remains of 50 seventeenth/eighteenth century Dutch whalers recovered from the Norwegian island of Zeeuwse Uytkijck in the Spitsbergen Archipelago (Maat 2004). A number of common pathological manifestations were identified including: black stains at the tips of the dental roots; bilateral metaphyseal stains on the lower extremities; and unilateral stains on the upper extremities, often at the insertion of muscles, that were linked with the physiological changes associated with scurvy. These changes were present in 80% of individuals (ibid.). Possible scurvy was also identified in 14.9% of 107 individuals from a nineteenth century migrant mining population from Kimberley in South Africa (Van der Merwe et al. 2010b). The defining criteria included ossified haematomas on the tibiae, widespread periosteal bone growth, and periodontal disease (ibid.). Using more diverse criteria, a recent study of 970 skeletons from Kilkenny workhouse in Ireland, directly associated with the Great Famine, lesions associated with scurvy were definitely identified in 16% (*n* 156) of individuals, probable scurvy in 14% (*n* 138), and possible scurvy in a further 21% (*n* 205) (Geber and Murphy 2012).

However, crucial factors to consider in a diagnosis of scurvy in skeletal remains, is that scurvy only begins to develop after six months of deficiency, and the skeletal lesions only occur when normal levels of vitamin C have been restored (Maat 2004; Van der Merwe et al. 2010a). In the present study, possible scurvy was identified in two juveniles and an adult from Cashel workhouse, and in two adults from the urban site from Shandon in Cork (see **Section 4.3.2.2** and **4.5.1.2**). It is certainly possible that some of the periosteal lesions, identified extensively in the present skeletal remains and examined in this chapter, were the result of ossifying haematoma's associated with scurvy. However, it could be argued, that one may not expect significant evidence of scurvy in, for example, a workhouse population. Those who died in the workhouses were physically weakened. They would have had firstly to survive long enough for the signs of scurvy to begin and secondly, would have had to have regained access to an intake of vitamin C for the skeletal lesions to manifest. This seems unlikely in the context of the known conditions and diets of the workhouses, particularly in the late 1840s and early 1850s. Therefore, this study interprets the periosteal lesions as being indicative of non-specific infection and general physiological stress.

7.4 Skeletal Manifestations of Infection

Infection is primarily confined to the soft tissues of the body. The inflammation that can occur as a result of infection may eventually lead to skeletal lesions. In reality, these only appear in a small percentage of those actually affected by the infectious process. For example, archival evidence linked the burials recently excavated from the Koffiefontein diamond mine in South Africa with a typhoid epidemic in 1896 (L'Abbe et al. 2003). Yet the evidence of infection on the individuals was scant (ibid.). Crucially, and somewhat ironically, individuals that present with evidence of infection are the ones that actually survived, at least for some time, and are therefore the healthier, stronger individuals in a population (Roberts 2000b; Wood et al. 1992). This in itself leads to an intriguing range of possibilities in terms of discussing the prevalence of infectious lesions in an archaeological sample (**Section 7.8**).

The infectious process, if unimpeded, is distinct when it does involve bone. Firstly the periosteum (the fibrous layer over the bone) is affected, then the infection can spread to the cortical bone, and finally into the medullary cavity (Larsen 1997). Each stage is more severe, and each with more significant consequences for the host. The bone changes associated with each stage are periostitis, osteitis, and osteomyelitis respectively. All three are caused by the micro-organisms *staphylococcus* and *streptococcus*, but periostitis may also occur as a result of a number of other factors (Goodman et al. 1984, 32). These include traumatic instances, as well as metabolic, neoplastic, and vascular disorders (Golding 1985, 706; Ortner 2003; Weston 2008).

Periostitis, a deposition of new bone on the normal exterior lamellar surface of the bone, is a very common finding in many archaeological skeletal samples (Larsen 1997; Mays 1998; Ortner 2003; Roberts and Cox 2003; Roberts and Manchester 1995; Steckel and Rose 2002). Indeed, as mentioned in the opening paragraph of this chapter, periostitis provides us with the earliest indication of inflammation in fossilised remains that are millions of years old (**Section 7.1**). Osteitis cannot be macroscopically defined in archaeological bones and, as most osteoarchaeologists do not have routine access to radiography, it is rarely reported on in the literature (Larsen 1997, 83). Osteomyelitis, which involves the medullary cavity of the bone, may be very distinct in visual terms. It is rarer than periostitis in archaeological skeletons as, by its nature, it is severe and, without antibiotics, a person may succumb to the infection before it progresses to this final extreme stage.

In periostitis, osteoblasts that line the subperiosteum become stimulated during the process of inflammation, thus triggering the formation of new bone (Larsen 1997, 83). When active, it appears as a layer of porous fibre bone, typically grey in colour, which overlies the normal surface of the bone. Macroscopically, it can be clearly seen as a separate layer at post-mortem breaks in the bone. It may be difficult to distinguish it from normal bone growth in infant individuals (Lewis 2004, 94; Lewis and Roberts 1997). The bone will gradually be remodelled into normal lamellar bone, but the porous lesions may still be visible on the surface of the bone and the bone may be abnormally thickened at that location. It is possible to distinguish between lesions that were active at the time of death and those that were healed or healing.

In osteomyelitis the infection invades the marrow cavity. The physical implication may be particularly detrimental to an individual's health and welfare. The infection reaches the marrow by one of three routes: directly through a traumatic or surgical wound; from infected adjacent soft tissue; or through blood from a remote septic focus (Ortner 2003, 181). It can be particularly distinct in archaeological bone as, without antibiotics, there is no cure, although, like any other disease, the severity may vary. The progress of the disease involves the formation of, often substantial, layers of bone (involucrum) over the normal surface of the bone, and the latter frequently suffers necrosis. These dead bone fragments (sequestra) may be extruded out of the bone and out through the flesh through draining sinuses (cloacae). Hence the term pyogenic, or pus-producing, osteomyelitis. Without antibiotics some cases will heal, others will be active for a long time, while others may be recurring. There is an estimated 20% mortality with osteomyelitis (ibid., 185).

Periostitis has almost invariably been linked in the osteoarchaeological literature with infection, both specific and non-specific, and is traditionally seen to occur as a result of the inflammation that is associated with bacterial infection. Viral infections tend to either be overcome quickly, or are rapidly fatal (Roberts 2000b, 146). In reality, as noted earlier, periostitis may occur when there is no infection, and crucially it can occur as a result of a multitude of other factors such as trauma and metabolic, neoplastic, and vascular disorders (Ortner 2003; Weston 2008; Golding 1985).

However, in some instances it is possible, on the basis of the pattern of distribution and other distinguishing skeletal factors, to determine a specific aetiology (Ortner 2003). The most common specific infections seen in archaeological skeletal remains are leprosy, tuberculosis, and treponemal diseases such as syphilis and yaws (Roberts 2000b, 146). Specific infections manifest in the same manner as non-specific infections. The key difference is the pattern of distribution of the lesions and sometimes the nature of the lesions themselves (Ortner 2003; Roberts 2000b, 146). For example, the final stages of syphilis can manifest with very distinctive lesions in the cranium called caries sicca, which is pathognomonic of the disease (Aufderheide and Rodríguez-Martín 1998; Ortner 2003).

The occurrence of periosteal lesions at multiple sites on the skeleton are typically indicative of a systemic infection, while isolated lesions may occur as a result of a number of factors (Larsen 1997, 83). Tibiae are frequently the most common location for evidence of infection to appear (Larsen 1997, 85; Roberts and Manchester 1995, 129-130). In fact, this location is so common that it has been applied as an index in a global study of health (Steckel et al. 2002). The high prevalence of the location is believed to be linked to the extensive vascularity and physiological inactive surfaces of the lower leg, the slower blood circulation, and the lack of soft tissue (Cotran et al. 1994; Larsen 1997, 85; Roberts 2000b, 148; Roberts and Manchester 1995). While periosteal lesions on the visceral surfaces on the ribs may linked with tuberculosis (Roberts et al. 1994), in reality they may be associated with any pulmonary infection (Mays et al. 2002).

7.5 Osteoarchaeological Studies

Unfortunately, the very nature of archaeological bone often militates against a definitive aetiology for any bone lesion. There are inherent archaeological biases within the excavation, for example works rarely entail the excavation of a complete cemetery. Differential preservation, even within a single site, can significantly affect the subsequent level and detail of osteoarchaeological analysis. Of course the cemetery context itself is defined ultimately by the society who dictates who should be buried there. Added to this, are the complexities of the examination of human bone itself. There is a basic premise that individuals with bony lesions of disease are actually the ones that were strong enough to survive for enough time for the disease to leave an osseous imprint (Wood et al. 1992). Such is particularly the case with periostitis: a person with a weakened immune system may succumb quickly to an infection and the disease may therefore leave no trace on the bone.

It has also been noted that periostitis may be caused by a variety of factors other than just infection. These include trauma, as well as metabolic, neoplastic, and vascular disorders (Ortner 2003). Scurvy was particularly referred to earlier (**Section 7.3.2**), given its sudden appearance during the Great Famine in particular. While there are valid cautions against applying such a 'blanket' interpretation of non-specific infection to these lesions (Weston 2008), studies (see below) have overwhelmingly indicated that most periosteal lesions indeed appear to be related to the inflammation associated with infection and should be interpreted as such, unless proven otherwise (Larsen 1997; Steckel et al. 2002, 89).

There are a multitude of individual reported cases of specific infections (for example, Anderson 2001; Buzhilova 1999; Mays et al. 2003; Mays and Taylor 2003; Mitchell 2003b; Nuorala 1999; Pfeiffer 1991). Others offer excellent and detailed insights into differential diagnoses procedures, which can only enrich the study of human bones (Buckley and Tayles 2003; Lefort and Bennike 2007; Weston 2008). While these are obviously important to the process of analysis of these lesions, and are vital in the interpretation of periostitis in particular, it is the larger-scale and broader studies that reveal a wealth of information on disease in the past.

The prevalence of periostitis has been used as a general indicator of health in numerous major skeletal studies. These include the Global History of Health Project, which uses periostitis as one of the seven basic indicators of the health status of humans (Steckel and Rose 2002), and the extensive review of health in Britain which was completed in the past decade (Roberts and Cox 2003). However ironically, as with many aspects of osteoarchaeology, the reporting of periostitis is very varied. For example, perhaps somewhat surprisingly, no non-specific infection/periostitis was reported for the infamous Spitalfields population from London (Roberts 2000b, 148). This aspect of variety in reporting of periostitis is examined in more detail elsewhere (**Section 4.2.4**).

As mentioned, periosteal lesions have been used to generally infer the health status of a wide variety of populations. Lesions attributed to non-specific infections have been extensively utilised in terms of assessing the impacts of social change on communities, particularly in terms of the impacts of the adoption of agriculture or to significant changes in primary foodstuffs (Eshed et al. 2010; Cohen 1989; Cohen and Armelagos 1984; Webb 1995). Generally the studies indicate that the adoption of agriculture saw a rise in the prevalence of periosteal lesions. This has been interpreted as reflecting a rise in physiological stress, but also importantly to an increased resistance to systemic insults (Eshed et al. 2010). The rise has been related to an increase in trade networks and general population increase and movement (Larsen 1997, 86). These are similar to the causative factors that revealed a change in general health associated with increased industrialisation (Lewis 2002).

Similarly, but on a more concentrated level, periosteal lesions have been studied to assess variations in skeletal health in populations from known socio-economic groups. The assessments of Afro-Americans cemeteries in the United States, both during slavery and post-slavery (from 1865 onwards), have yielded perhaps some of the most detailed information regarding periosteal lesions and the link with increased physiological stresses. There is considerable documentary evidence to record the actual living conditions of these individuals, and the cemeteries frequently have a limited time use. Almost 90% of the 80 skeletons recovered from the post-emancipation cemetery at Cedar Grove in southwest

Arkansas had evidence of infection, which links in with a documented decline in health for this individuals in that period (Rose 1989). Documented health decline in post-civil war America has similarly been identified skeletally with high infection levels in individuals born in that period and curated as anatomical collections (de la Cova 2011). Clear skeletal indicators of infectious disease have been noted in a small sample of enslaved excavated from Eaton's Estate in North Carolina (Lambert 2006), as well as in individuals from Newton Plantation in Barbados (Shuler 2011). It has been found that the health of free blacks in Philadelphia at the start of the nineteenth century was considerably better than the health of slaves in South Carolina later on in the century (Rathbun and Steckel 2002).

7.6 Bioarchaeological Expectations of Present Study

One of the most confounding aspects in terms of osteoarchaeological studies is that, if periostitis is indicative of general physiological stress and particularly infections, then the prevalence rates, as established from archaeological cemeteries, cannot be reliable. The conflict lies in the fact that an individual has to survive for long enough for the lesions to appear. The individuals who die quickly will not present with the lesions (see **Section 2.5.1**). As noted earlier (**Section 7.4**), skeletal lesions of infection typically relate to chronic bacterial infections, rather than the acute viral infections. In addition, depending on a myriad of factors including, but not limited to, general overall health, diet, age, sex, occupation, habitation, and education, some individuals may recover quickly and so never present with skeletal lesions. It would be a serious error to blithely assume that skeletons that present with lesions of infections are representative of the prevalence of the disease in that group. In addition, there are other complicating factors to consider in archaeological cemeteries. These include the possibility that burials may span a considerable period of time, and also most archaeological cemetery assemblages are just samples of a bigger cemetery. The key to addressing this perplexing issue of the reliability of the actual skeletal markers is to assess specific cemetery populations, of a known origin and date, and using recognised stress markers. An historically documented population is crucial for contextualising the data from the skeletal remains (de la Cova 2011) (**Section 2.5.1**).

This study approaches periosteal lesions in terms of them being representative of general physiological stress associated with infections. The present study of non-specific infection addressed a series of questions, based on a number of logical expectations, which in turn are based specifically on the known origin of the groups. The three post-medieval population groups represent, respectively, a low status group from Union Workhouses, a middleclass socio-economic group from a selection of Protestant cemeteries, and an urban group that, in socio-economic terms, should be somewhere between the first two groups. These expectations of the study of non-specific infection in these groups include:

- Overall, prevalence rates of non-specific infection would be expected to have generally increased from the medieval period, due to the increased load of population, disease epidemics, food shortages, and increased urbanisation and its associated problems in that period. Is this the case here?
- The Workhouse group is traditionally interpreted as the most socially-deprived of the three groups and therefore the most vulnerable to physiological stresses, and particularly to insults of infectious diseases. It is expected that the prevalence rates of skeletal lesions should be highest in that group. Conversely, given their general socio-economic status, it may be expected that the prevalence rates would be lowest in the middleclass population, while the mixed urban group, should perhaps be in between the two. Does the skeletal evidence conform to this?
- Although the poor were more typically the victims of disease epidemics, they may also have built up a certain level of immunity to infectious insults. Is there evidence of repeated episodes of infection in this group? What is the evidence of healing? It may be suggested that there should be less evidence of healing in the higher socio-economic group. In addition, given that an individual has to survive long enough for the bone lesions to occur, how do the prevalence rates marry with that basic fact?
- Based on the evidence of other studies, it is expected that males would be more at risk of infection than females. Is this true in these population groups and how do they compare with each other?
- Systemic infections are the ones most likely to eventually manifest on the bone, and these are most frequently indicated by multiple bones being involved. What is the pattern of bone involved? Is there evidence of systemic infections?

The prevalence rates used to examine these questions are detailed in **Section 4.2.4**.

7.7 Results of Analysis

7.7.1 Total CPRs and Sex Differences

The crude prevalence rates (CRP) of non-specific lesions in all observable individuals are provided in **Table 7.2**.

Table 7.2.
CPRs of total numbers of individuals with non-specific infections, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

	n	***N***	**CPR %**
Workhouse	30	67	44.8
Middleclass	7	43	16.3
Urban	87	225	38.7
Total	*124*	*335*	*37.0*

The CRPs of the three groups were compared using Pearson's chi-square test, in order to determine if the variations observed above were statistically significant. The results are presented in **Table 7.3**.

Table 7.3.
Chi square variances in CRP of non-specific infection, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	***n/N* (%)**	**Site Class**	***n/N***	**Chi Square**
Workhouse	30/67 (44.8)	Middleclass	7/43 (16.3)	X^2 (1) = 9.5282, p = **0.002**
Workhouse	30/67 (44.8)	Urban	87/225 (38.7)	X^2 (1) = 0.8025, p = 0.370
Middleclass	7/43 (16.3)	Urban	87/225 (38.7)	X^2 (1) = 7.9455, p = **0.005**

The CPRs in both the workhouse (44.8% 30/67) and the urban group (38.7% 87/225) were significantly higher than the CPR in the middleclass group (16.3% 7/43) (see highlighted in **Table 7.3**). However, there was no significant difference between the CPR of non-specific infection in the workhouse and the urban groups.

Due to difficulties in determining specific age-at-death for adult individuals, it was not possible to assess the prevalence rates of non-specific infection by age. However, it was possible to assess the CPR of the periostitis by sex. A total of 30.8% of females (41/133) and

45.2% of males (71/157) presented with the lesions, and the difference was statistically significant (X^2 (1) = 6.2949, p = **0.012**).

The prevalence of non-specific infection was then examined in more detail in both the females and the males. It had already been determined that the CPR was high in both the workhouse and the urban group and low in the middleclass group and that, overall, males were more frequently affected. The CPRs of both sexes were then assessed individually in terms of the three distinct groups in order to determine if a higher CPR in males was universal. The results are presented in **Table 7.4,** along with the assessment of the results using Pearson's chi-square test.

Table 7.4.
Chi square variances in CPR of non-specific infection between female and male adults, by group (*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Female *n/N* (%)	Male *n/N* (%)	Chi Square
Workhouse	12/35 (34.3)	18/31 (58.1)	X^2 (1) = 3.7491, p = 0.053
Middleclass	2/11 (18.2)	4/25 (16)	X^2 (1) = 0.0262, p = 0.871
Urban	27/87 (31)	49/101 (48.5)	X^2 (1) = 5.9302, p = **0.015**

Although males had a higher CPR of non-specific infection than females in both the workhouse group and urban group, only the latter variation was statistically significant (see highlighted in **Table 7.4**). There was no significance either in the marginally higher rate in middleclass females (18.2% 2/11) over their male counterparts (16% 4/25).

The females and males were then individually assessed in order to determine if either sex had higher or lower CPRs in particular groups. The results, along with the Pearson's chi-square test results, are presented in **Table 7.5** and **Table 7.6**.

Table 7.5.
Chi square variances in CRP of non-specific infection between females, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Female *n/N* (%)	Site Class	Female *n/N* (%)	Chi Square
Workhouse	12/35 (34.3)	Middleclass	2/11 (18.2)	X^2 (1) = 1.0252, p = 0.311
Workhouse	12/35 (34.3)	Urban	27/87 (31)	X^2 (1) = 0.1213, p = 0.728
Middleclass	2/11 (18.2)	Urban	27/87 (31)	X^2 (1) = 0.7742, p = 0.379

Table 7.6.
Chi square variances in CRP of non-specific infection between males, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Male *n/N* (%)	Site Class	Male *n/N* (%)	Chi Square
Workhouse	18/31 (58.1)	Middleclass	4/25 (16)	X^2 (1) = 10.2664, p = **0.001**
Workhouse	18/31 (58.1)	Urban	49/101 (48.5)	X^2 (1) = 0.8655, p = 0.352
Middleclass	4/25 (16)	Urban	49/101 (48.5)	X^2 (1) = 8.6935, p = **0.003**

Despite the fact that the CPRs of non-specific infection in the females suggested that there were differences in prevalence between the middleclass group (18.2% 2/11) and the workhouse and middleclass groups (34.3% 12/35 and 31% 27/87 respectively), the differences were not statistically significant (see **Table 7.5**).

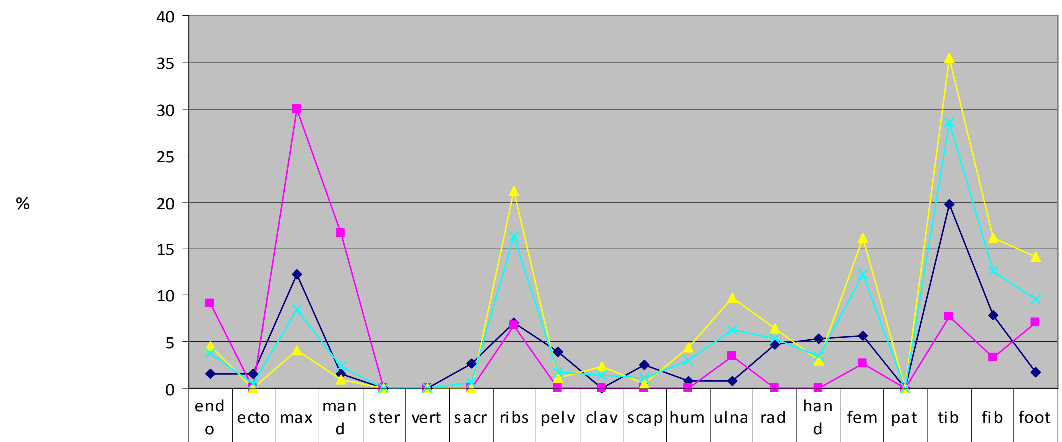
In contrast, significant variations were apparent between the high CPR in the males in the workhouse (58.1% 18/31) and the males in the urban group (48.5% 49/101) in comparison with the males in the middleclass group (16% 4/25) (see highlighted in **Table 7.6**). No significant difference was apparent in the CPR of non-specific infection in the males in the workhouse and urban groups.

7.7.2 Prevalences in Individual Bones and Sex Differences

True prevalence rates (TPR), by skeletal element, are provided below in **Table 7.7** and **Figure 7.1**, with the data divided by site type, and totals also provided.

Table 7.7.
TPR of non-specific infection, by group
(*n* = number of bones with lesions, *N* = total observable bones)

Bone	Workhouse *n/N (%)*	Middleclass *n/N (%)*	Urban *n/N (%)*	TOTAL *n/N (%)*
Endocranial	1/64 (1.6)	1/11 (9.1)	5/112 (4.5)	7/187 (3.7)
Ectocranial	1/64 (1.6)	0/11 (0)	0/112 (0)	1/187 (0.5)
Maxilla	7/57 (12.3)	3/10 (30)	4/97 (4.1)	14/164 (8.5)
Mandible	1/64 (1.6)	2/12 (16.7)	1/97 (1)	4/173 (2.3)
Sternum	0/31 (0)	0/10 (0)	0/82 (0)	0/123 (0)
Vertebra	0/62 (0)	0/21 (0)	0/157 (0)	0/240 (0)
Sacrum	1/39 (2.6)	0/14 (0)	0/97 (0)	1/150 (0.7)
Ribs	7/100 (7)	2/30 (6.7)	52/245 (21.2)	61/375 (16.3)
Pelvis	4/103 (3.9)	0/33 (0)	3/266 (1.1)	7/402 (1.7)
Clavicle	0/122 (0)	0/25 (0)	5/214 (2.3)	5/361 (1.4)
Scapula	3/119 (2.5)	0/26 (0)	1/228 (0.4)	4/373 (1.1)
Humerus	1/126 (0.8)	0/27 (0)	11/248 (4.4)	12/401 (3)
Ulna	1/128 (0.8)	1/29 (3.4)	22/227 (9.7)	24/384 (6.3)
Radius	6/127 (4.7)	0/28 (0)	14/218 (6.4)	20/373 (5.4)
Hand	6/113 (5.3)	0/32 (0)	6/200 (3)	12/345 (3.5)
Femur	7/124 (5.6)	1/37 (2.7)	47/290 (16.2)	55/451 (12.2)
Patella	0/97 (0)	0/22 (0)	0/144 (0)	0/263 (0)
Tibia	24/121 (19.8)	3/39 (7.7)	94/265 (35.5)	121/245 (28.5)
Fibula	9/114 (7.9)	1/30 (3.3)	37/230 (16.1)	47/374 (12.6)
Foot	2/109 (1.8)	2/28 (7.1)	29/206 (14.1)	33/343 (9.6)



	endo	ecto	max	mand	ster	vert	sacr	ribs	pelv	clav	scap	hum	ulna	rad	hand	fem	pat	tib	fib	foot
Workhouse	1.6	1.6	12.3	1.6	0	0	2.7	7	3.9	0	2.5	0.8	0.8	4.7	5.3	5.6	0	19.8	7.9	1.8
Middleclass	9.1	0	30	16.7	0	0	0	6.7	0	0	0	0	3.4	0	0	2.7	0	7.7	3.3	7.1
Urban	4.5	0	4.1	1	0	0	0	21.2	1.1	2.3	0.4	4.4	9.7	6.4	3	16.2	0	35.5	16.1	14.1
Total	3.7	0.5	8.5	2.3	0	0	0.7	16.3	1.7	1.4	1.1	3	6.3	5.4	3.5	12.2	0	28.5	12.6	9.6

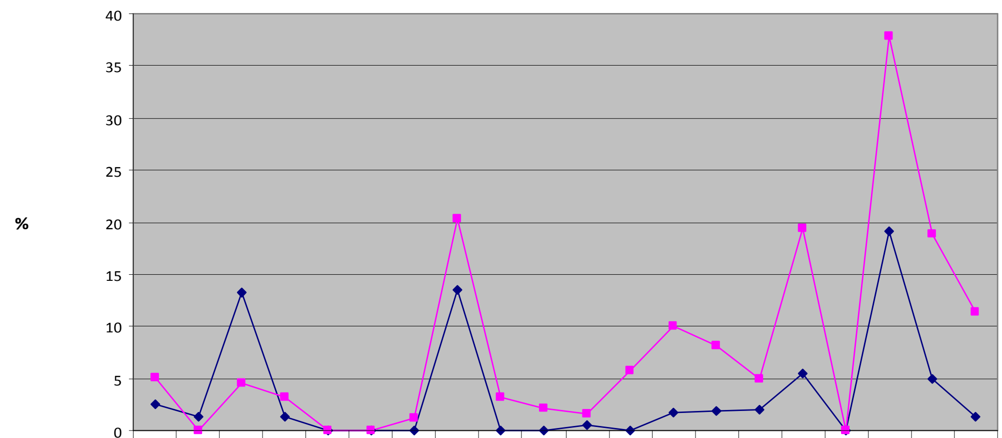
Figure 7.1.
TPR of non-specific infection, by group and total TPR
(includes females, males, and unsexed adults)

Endocranial lesions in particular were limitedly observed, as while the cranium may be present, it may not be always observable, for example, if the skull was complete. Overall, lesions of non-specific infection were particularly prominent, in all groups, in the maxilla, the ribs, and the limb bones, with the bones of the legs being particularly prominent. The highest prevalence was in the tibiae of the urban group with 35.5% (94/265) of tibiae affected. It was apparent that the lesions peaked most in the urban group overall, particularly in terms of the ribs, and in the long bones of the arm and particularly the leg. In the middleclass group the lesions were particularly prominent in the cranium: endocranially, and on the maxilla and mandible. Lesions on the latter two were invariably associated with dental health.

The TPRs were also examined in terms of females and males, in order to ascertain if either sex showed distinct patterns in terms of bones affected by non-specific infection. The TPRs by sex of the three groups, plus the amalgamated totals, are provided below in **Table 7.8**, while the female and male totals are shown in **Figure 7.2**.

Table 7.8.
TPR of non-specific infection by sex and group
(*n* = number of bones with lesions, *N* = total observable bones)

Bone	**Workhouse**		**Middleclass**		**Urban**		**TOTAL**	
	Female	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*
	n / N	*n / N*	*n / N*	*n / N*	*n / N*	*n / N*	*n / N*	*n / N*
Endocranial	1/34	0/30	1/2	0/9	0/44	5/60	2/80	5/99
Ectocranial	1/34	0/30	0/2	0/9	0/44	0/60	1/80	0/99
Maxilla	6/28	1/29	0/3	3/7	3/37	1/53	9/68	4/89
Mandible	1/34	0/30	0/4	2/8	0/32	1/55	1/70	3/93
Sternum	0/14	0/17	0/3	0/6	0/29	0/47	0/46	0/73
Vertebra	0/33	0/29	0/7	0/13	0/60	0/81	0/100	0/123
Sacrum	0/22	1/17	0/5	0/9	0/35	0/58	0/62	1/84
Ribs	5/53	2/47	0/8	2/19	16/95	35/125	21/156	39/191
Pelvis	0/51	4/52	0/13	0/20	0/109	3/141	0/173	7/213
Clavicle	0/65	0/57	0/6	0/18	0/86	4/108	0/157	4/183
Scapula	1/64	2/55	0/8	0/17	0/89	1/116	1/161	3/188
Humerus	0/67	1/58	0/6	0/20	0/95	11/129	0/168	12/207
Ulna	0/66	1/60	1/10	0/18	2/88	19/122	3/164	20/200
Radius	3/65	3/60	0/8	0/18	0/83	13/119	3/156	16/197
Hand	3/56	3/55	0/13	0/19	0/80	6/108	3/149	9/182
Femur	0/65	7/57	0/10	1/21	11/125	34/139	11/200	42/217
Patella	0/49	0/48	0/8	0/12	0/56	0/80	0/113	0/140
Tibia	2/63	22/56	0/12	3/25	34/113	50/117	36/188	75/198
Fibula	0/55	9/57	0/11	1/19	8/97	25/110	8/163	35/186
Foot	0/55	2/53	0/4	0/20	2/84	18/102	2/143	20/175

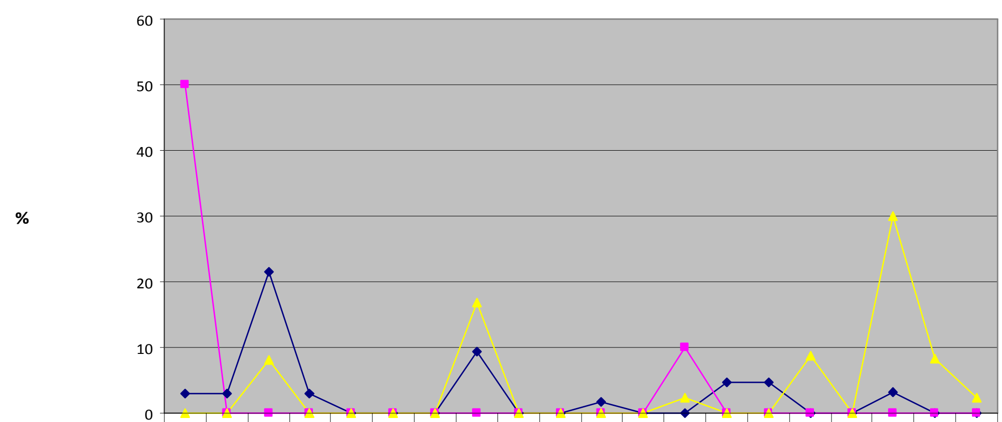


	endo	ecto	max	mand	ster	vert	sacr	ribs	pelv	clav	scap	hum	ulna	rad	hand	fem	pat	tib	fib	foot
Female	2.5	1.3	13.2	1.4	0	0	0	13.5	0	0	0.6	0	1.8	1.9	2	5.5	0	19.1	4.9	1.4
Male	5.1	0	4.5	3.2	0	0	1.2	20.4	3.2	2.2	1.6	5.8	10	8.1	4.9	19.4	0	37.9	18.8	11.4

Figure 7.2.
Total TPR of non-specific infection, by sex

It has already been observed that, overall, males had a higher prevalence of non-specific infection than females (45.2% and 30.8% respectively). This is clearly apparent in **Figure 7.2**, where males have a higher TPR in almost all of the skeletal elements than the female individuals. The exception is the maxilla, where females had a higher TPR than their male counterparts (13.2% 9/68 and 4.5% 4/89 respectively). Again, the maxilla, ribs, and limb bones were most commonly affected in both sexes.

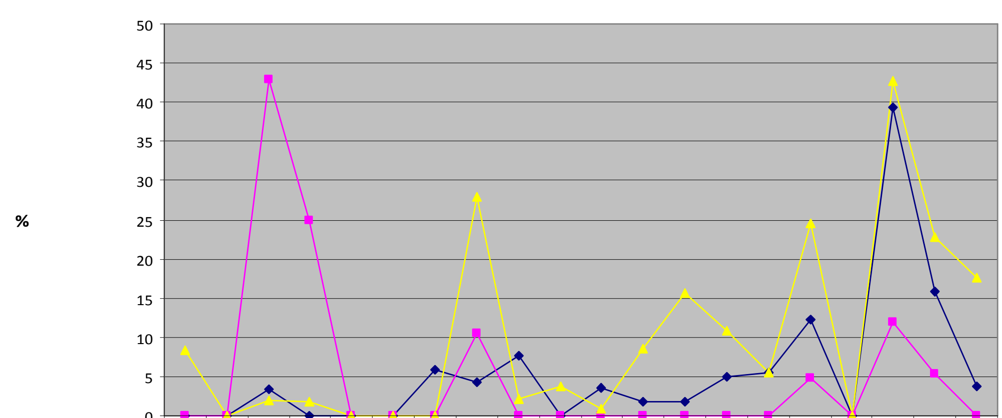
Both sexes were also examined individually in order to determine if any particular group showed a distinct pattern over another group. The female data is presented in **Figure 7.3** while the male data is presented in **Figure 7.4**.



	endo	ecto	max	man d	ster	vert	sacr	ribs	pelv	clav	scap	hum	ulna	rad	hand	fem	pat	tib	fib	foot
Workhouse	2.9	2.9	21.4	2.9	0	0	0	9.4	0	0	1.6	0	0	4.6	4.6	0	0	3.2	0	0
Middleclass	50	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
Urban	0	0	8.1	0	0	0	0	16.8	0	0	0	0	2.3	0	0	8.8	0	30.1	8.2	2.4

Figure 7.3.
TPR of non-specific infection in females, by group

In the females, overall, those in the middleclass group were least involved in all except endocranial bone lesions and in lesions on the ulnae, in comparison to their contemporaries in the workhouse and the urban groups. The lower limb bones feature prominently in the urban group.



	endo	ecto	max	man d	ster	vert	sacr	ribs	pelv	clav	scap	hum	ulna	rad	hand	fem	pat	tib	fib	foot
Workhouse	0	0	3.4	0	0	0	5.9	4.3	7.7	0	3.6	1.7	1.7	5	5.5	12.3	0	39.3	15.8	3.8
Middleclass	0	0	42.9	25	0	0	0	10.5	0	0	0	0	0	0	0	4.8	0	12	5.3	0
Urban	8.3	0	1.9	1.8	0	0	0	28	2.1	3.7	0.9	8.5	15.6	10.9	5.6	24.5	0	42.7	22.7	17.6

Figure 7.4.
TPR of non-specific infection in males, by group

The high prevalence of non-specific infection in the male individuals is apparent in **Figure 7.4**. The ribs and limbs generally have high prevalence rates, while maxillary lesions are very high in the middleclass group. This is primarily related to dental disease.

7.7.2.1 CPRs of Tibial and Rib Lesions

Periosteal lesions in the tibiae and the ribs were common in this study, and are frequently observed in other osteoarchaeological studies. Due to variations in recording in published reports (**Section 7.5**), it was decided to assess lesions in these bones in terms of CPR, even though TPRs have already been established above (**Section 7.7.2**). In a review of the literature it became apparent that the CPR of periostitis in the tibia and the ribs is more frequently recorded than TPR.

The overall CPR of tibial lesions in this study was 30.9% (71/230). The CPR of tibial periostitis in each group is provided in **Table 7.9**.

Table 7.9.
CPRs of total numbers of individuals with tibial periostitis, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

	n	***N***	**CPR %**
Workhouse	14	61	23
Middleclass	2	23	8.7
Urban	55	146	37.7
Total	*71*	*230*	*30.9*

The chi square differences between the CPRs for tibial lesions in each of the groups are provided in **Table 7.10**.

Table 7.10.
Chi square variances in CPR of tibial periostitis, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	***n*/*N* (%)**	**Site Class**	***n*/*N***	**Chi Square**
Workhouse	14/61 (23)	Middleclass	2/23 (8.7)	X^2 (1) = 2.2012, p = 0.138
Workhouse	14/61 (23)	Urban	55/146 (37.7)	X^2 (1) = 4.1953, p = **0.041**
Middleclass	2/23 (8.7)	Urban	55/146 (37.7)	X^2 (1) = 7.4634, p = **0.006**

The urban CPR of tibial lesions (37.7% 55/146) was significantly higher that the CPR in both the workhouse (23% 14/61) and the middleclass group (8.7% 2/23) (see highlighted in **Table 7.10**). There was no significant difference between the workhouse and the middleclass CPRs.

Males (37.9% 75/198) had a higher TPR of tibial lesions than females (19.1% 36/188), and those differences were statistically significant (X^2 (1) = 16.5129, p = **0.000**). When the CPR of tibial lesions were compared by sex, males still had a higher prevalence (40.6% 43/106), with a CPR almost twice that seen in the females (20.8% 21/101) (X^2 (1) = 9.4862, p = **0.002**). In order to assess if the higher male prevalence of tibial lesions was universal across the three groups, the sexes were individually compared within each group (**Table 7.11**).

Table 7.11.
Chi square variances in CPR of tibial periostitis in female and male adults, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	**Female** *n/N* **(%)**	**Male** *n/N* **(%)**	**Chi Square**
Workhouse	1/32 (3.1)	13/28 (46.4)	X^2 (1) = 15.6538, p = **0.000**
Middleclass	0/7 (0)	2/15 (13.3)	X^2 (1) = 1.0267, p = 0.311
Urban	20/62 (32.3)	28/63 (44.4)	X^2 (1) = 1.9618, p = 0.161

Males did have higher CPR of tibial lesions in all three groups. However, only the male CPR in the workhouse (46.4% 13/28) was significantly higher than the females (3.1% 1/32) in the same group.

Both sexes were then individually tested in order to determine if either sex showed a significantly higher CPR in any group. The results for the females and the males are provided below in **Table 7.12** and **Table 7.13**.

Table 7.12.
Chi square variances in CPR of tibial periostitis between females, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	**Female** *n / N* **(%)**	**Site Class**	**Female** *n / N* **(%)**	**Chi Square**
Workhouse	1/32 (3.1)	Middleclass	0/7 (0)	X^2 (1) = 0.2245, p = 0.636
Workhouse	1/32 (3.1)	Urban	20/62 (32.3)	X^2 (1) = 10.3252, p = **0.001**
Middleclass	0/7 (0)	Urban	20/62 (32.3)	X^2 (1) = 3.1797, p = 0.075

In the females, very low CPRs were recorded in both the workhouse and the middleclass group. In fact no females in the middleclass group presented with tibial periostitis. In contrast the CPR was quite high in the urban group (32.3% 20/62). Statistically, only the difference between the high prevalence in the urban females and the low prevalence in the workhouse females was significant.

Table 7.13.
Chi square variances in CPR of tibial periostitis between males, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Male *n* / *N* (%)	Site Class	Male *n* / *N* (%)	Chi Square
Workhouse	13/28 (46.4)	Middleclass	2/15 (13.3)	X^2 (1) = 4.7098, p = **0.030**
Workhouse	13/28 (46.4)	Urban	28/63 (44.4)	X^2 (1) = 0.0308, p = 0.861
Middleclass	2/15 (13.3)	Urban	28/63 (44.4)	X^2 (1) = 4.9544, p = **0.026**

In the males, similar tibial CPRs were recorded in the workhouse (46.4% 13/28) and the urban groups (44.4% 28/63). Both were significantly higher than the CPR recorded in the middleclass group (13.3% 2/15).

The overall CPR of rib lesions was 20.4% (43/211). The CPRs for each of the three groups is provided in **Table 7.14**.

Table 7.14.
CPRs of total numbers of individuals with periosteal rib lesions, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

	n	*N*	CPR %
Workhouse	4	54	7.4
Middleclass	1	18	5.6
Urban	38	139	27.3
Total	*43*	*211*	*20.4*

The chi square differences between the CPRs for rib lesions in each of the groups is provided in **Table 7.15**.

Table 7.15.
Chi square variances in CPR of periosteal rib lesions, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	*n/N* (%)	Site Class	*n/N*	Chi Square
Workhouse	4/54 (7.4)	Middleclass	1/18 (5.6)	X^2 (1) = 0.0716, p = 0.789
Workhouse	4/54 (7.4)	Urban	38/139 (27.3)	X^2 (1) = 9.0737, p = **0.003**
Middleclass	1/18 (5.6)	Urban	38/139 (27.3)	X^2 (1) = 4.0500, p = **0.044**

The urban CPR of rib lesions (27.3% 38/139) was significantly higher (see highlighted in **Table 7.15**) than the CPR in both the workhouse (7.4% 4/54) and the middleclass (5.6% 1/18) groups. There was no significant difference between the latter two groups.

Males (20.4% 39/191) had a higher TPR of rib lesions than females (13.5% 21/156), but the difference was not statistically significant (X^2 (1) = 2.9063, p = 0.088). The CPR of rib periostitis was 16.1% (14/87) of females and 25.7% (27/105) of males, and again, the difference was not statistically significant (X^2 (1) = 2.6231, p = 0.105). The females and males were also compared within each group, and the chi square differences are provided in **Table 7.16**.

Table 7.16.
Chi square variances in CPR of periosteal lesions in ribs in female and male adults, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Female *n/N* (%)	Male *n/N* (%)	Chi Square
Workhouse	3/28 (10.7)	1/26 (3.8)	X^2 (1) = 0.9272, p = 0.336
Middleclass	0/5 (0)	1/11 (9.1)	X^2 (1) = 0.4848, p = 0.486
Urban	11/54 (20.4)	25/68 (36.8)	X^2 (1) = 3.8891, p = **0.049**

Females in the workhouse had a higher CPR the males, while males in the middleclass group had a higher CPR of rib lesions over the females. However, neither variation was statistically significant. Within the urban group, males had almost twice the CPR (36.8% 25/68) than females (20.4% 11/54) and the difference was statistically significant (see highlighted in **Table 7.16**).

Both sexes were also individually compared across the groups. The results, along with chi square results, are provided in **Table 7.17** and **7.18**.

Table 7.17.
Chi square variances in CPR of periosteal rib lesions between females, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Female *n/N* (%)	Site Class	Female *n/N* (%)	Chi Square
Workhouse	3/28 (10.7)	Middleclass	0/5 (0)	X^2 (1) = 0.5893, p = 0.443
Workhouse	3/28 (10.7)	Urban	11/54 (20.4)	X^2 (1) = 1.2143, p = 0.270
Middleclass	0/5 (0)	Urban	11/54 (20.4)	X^2 (1) = 1.2519, p = 0.263

No significant difference was present between the females in the various groups, despite the fact that no periosteal lesions were recorded in the ribs of the females in the middleclass group.

Table 7.18.
Chi square variances in CPR of periosteal rib lesions between males, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Male *n / N* (%)	Site Class	Male *n / N* (%)	Chi Square
Workhouse	1/26 (3.8)	Middleclass	1/11 (9.1)	X^2 (1) = 0.4158, p = 0.519
Workhouse	1/26 (3.8)	Urban	25/68 (36.8)	X^2 (1) = 10.1861, p = **0.001**
Middleclass	1/11 (9.1)	Urban	25/68 (36.8)	X^2 (1) = 3.2841, p = 0.070

In the male individuals, high CPRs of rib lesions were present in the urban group (36.8% 25/68). This was significantly higher than the CPR recorded in the workhouse males (3.8% 1/26) (see highlighted in **Table 7.18**).

7.7.3 CPRs by Limb Bones Only and Sex Differences

While the analysis concentrated on examining non-specific infection in terms of all bones in the body, consideration was also given separately to the long bones. This is due to the fact that many osteoarchaeological reports refer only to lesions on the limb bones (see **Section 7.5**). The crude prevalence rates (CRP) of non-specific lesions in all observable individuals with any of the humerus, radius, ulna, femur, tibia, and fibula, are provided in **Table 7.19**.

Table 7.19.
CPRs of total numbers of individuals with long bones with non-specific infections, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

	n	***N***	**CPR %**
Workhouse	16	67	23.9
Middleclass	3	38	7.9
Urban	72	219	32.9
Total	*91*	*324*	*28.1*

The CPR drops from 37% (124/335) of individuals with infection in any bone (**Section 7.7.1**) to CPR 28.1% (91/324) of individuals with infection in just one of the six major long bones. This varies from the CPRs for non-specific infection on all bones in all adults earlier established, which found the highest prevalence was in the workhouse at CPR 44.8% (30/67), as the highest CPR now appears in the urban group (**Table 7.19**). The CRPs of the periostitis in individuals with observable long bones were compared using Pearson's chi-square test, in order to determine if the variations in **Table 7.19** were statistically significant. The results are presented in **Table 7.20**.

Table 7.20.
Chi square variances in CPR of periostitis by long bones only, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	***n/N* (%)**	**Site Class**	***n/N***	**Chi Square**
Workhouse	16/67 (23.9)	Middleclass	3/38 (7.9)	X^2 (1) = 4.1809, p = **0.041**
Workhouse	16/67 (23.9)	Urban	72/219 (32.9)	X^2 (1) = 1.9492, p = 0.163
Middleclass	3/38 (7.9)	Urban	72/219 (32.9)	X^2 (1) = 9.7787, p = **0.002**

This broadly conforms to the CPRs for non-specific infection on all bones in all adults earlier. The CPR of individuals with limb bones with periostitis was 23.9% (16/67) in the workhouse group and 32.9% (72/219) in the urban group. Although there was no significant difference between these prevalences, both were significantly higher than the CPR of 7.9% (3/38) in the middleclass group (see highlighted in **Table 7.20**).

The prevalence of periostitis by individuals with observable long bones was also assessed in terms of sex. In total, CPR 18.3% (24/131) of females and CPR 33.8% (52/154) of males, with one or more long bone present, had periosteal lesions. The difference was statistically significant (X^2 (1) = 8.6355, p = **0.003**).

The prevalence of non-specific infection by long bone was then examined for each group by sex, in order to determine if the male prevalence was common across the three groups. The results are presented in **Table 7.21,** along with the assessment of the results using Pearson's chi-square test.

Table 7.21.
Chi square variances in CPR of periosteal lesions by long bones, by sex and by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Female *n*/*N* (%)	Male *n*/*N* (%)	Chi Square
Workhouse	2/35 (5.7)	14/31 (45.2)	X^2 (1) = 13.9287, *p* = **0.000**
Middleclass	1/10 (10)	2/23 (8.7)	X^2 (1) = 0.0143, *p* = 0.905
Urban	21/86 (24.4)	36/100 (36)	X^2 (1) = 2.9179, *p* = 0.088

Although males had a higher CPR of non-specific infection than females in both the workhouse group and urban group, only the former variation was statistically significant (see highlighted in **Table 7.21**). In fact just CPR 5.7% (2/35) of females with limb bones in the workhouse has periostitis, in comparison to CPR 45.2% (14/31) males. Although females had a marginally higher prevalence in the middleclass group, the variation was not statistically significant.

The females and males were then individually assessed in order to determine if either sex had higher or lower CPRs in particular groups. The results, along with the Pearson's chi-square test results, are presented in **Table 7.22** and **Table 7.23**.

Table 7.22.
Chi square variances in CPR of non-specific infection in long limb bones between females, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Female *n*/*N* (%)	Site Class	Female *n*/*N* (%)	Chi Square
Workhouse	2/35 (5.7)	Middleclass	1/10 (10)	X^2 (1) = 0.2296, *p* = 0.632
Workhouse	2/35 (5.7)	Urban	21/86 (24.4)	X^2 (1) = 5.6530, *p* = **0.017**
Middleclass	1/10 (10)	Urban	21/86 (24.4)	X^2 (1) = 1.0543, *p* = 0.305

Table 7.23.
Chi square variances in CPR of non-specific infection in long limb bones between males, by group (*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	Male *n*/*N* (%)	Site Class	Male *n*/*N* (%)	Chi Square
Workhouse	14/31 (45.2)	Middleclass	2/23 (8.7)	X^2 (1) = 8.4207, p = **0.004**
Workhouse	14/31 (45.2)	Urban	36/100 (36)	X^2 (1) = 0.8416, p = 0.359
Middleclass	2/23 (8.7)	Urban	36/100 (36)	X^2 (1) = 6.5297, p = **0.011**

When analysis was undertaken above on the differences in prevalences between females with non-specific infection in all observable bones (**Table 7.5**), no significant difference was apparent. However, when periosteal prevalence rates in females with long bones were considered a significant difference was apparent between the CPR of females in the urban group (24.4%, 21/86) over those in the workhouse (CPR 5.7%, 2/35) (see highlighted in **Table 7.22**).

In males, significantly higher prevalence rates of periosteal lesions in the long bones were present in both the workhouse group (CPR 45.2%, 14/31) and the urban group (CPR 36%, 36/100) over the middleclass group (CPR 8.7%, 2/23) (see highlighted in **Table 7.23**). This was similar to the findings in CPRs when all bones were considered (**Table 7.6**).

Finally, the lesions in the limbs were also assessed in terms of prevalence rates of upper (humerus, radius, ulna) and lower (femur, tibia, fibula) limbs. In total the upper limbs had a CPR of 7.2% (19/265) and the lower limbs had a CPR of 28.6% (78/273). The difference was statistically significant (X^2 (1) = 41.6748, p = **0.000**).

7.8.4 Assessment of Multiple Lesions and Sex Differences

All individuals were also assessed in terms of the numbers of bones affected, in particular to assess if multiple or single bones were more frequently involved. In total 81/124 or CPR 65.3% of the individuals had more than one bone affected by periosteal lesions. The prevalence of multiple lesions were compared between each of the three groups in order to determine if any group showed a significantly higher prevalence. The results are presented in **Table 7.24**.

Table 7.24.
Chi square variances in CPR of multiple lesions of non-specific infection, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	19/30 (63.3)	Middleclass	3/7 (42.9)	X^2 (1) = 0.9872, p = 0.320
Workhouse	19/30 (63.3)	Urban	59/87 (67.8)	X^2 (1) = 0.2017, p = 0.653
Middleclass	3/7 (42.9)	Urban	59/87 (67.8)	X^2 (1) = 1.7974, p = 0.180

Although there were differences in the CPRs of the presence of multiple lesions of non-specific infection they were not statistically significant (see **Table 7.24**), indicating that no group showed a distinctly high or low prevalence of multiple lesions.

The prevalence of multiple lesions was also examined in terms of sex. A total CPR of 56.1% of females (23/41) and 76.1% of males (54/71) with infectious lesions presented with multiple lesions. The difference in the CPR between the two sexes was statistically significant (X^2 (1) = 4.8191, p = **0.028**).

Although no variation was apparent in the CPR of multiple lesions between the three groups (**Table 7.24** above), the data was also compared by sex through each of the three groups, in order to determine if any patterns could be determined. That data is presented in **Table 7.25** and **7.26**.

Table 7.25.
Chi square variances in CPR of multiple lesions in females, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	6/12 (50)	Middleclass	2/11 (18.2)	X^2 (1) = 2.5614, p = 0.110
Workhouse	6/12 (50)	Urban	17/27 (63)	X^2 (1) = 0.5770, p = 0.447
Middleclass	2/11 (18.2)	Urban	17/27 (63)	X^2 (1) = 6.2694, p = **0.012**

Table 7.26.
Chi square variances in CPR of multiple lesions in males, by group
(*n* = number of individuals with lesions, *N* = total observable individuals)

Site Class	*n/N* (%)	Site Class	*n/N* (%)	Chi Square
Workhouse	13/18 (72.2)	Middleclass	2/4 (50)	X^2 (1) = 0.7450, p = 0.388
Workhouse	13/18 (72.2)	Urban	39/49 (79.6)	X^2 (1) = 0.4115, p = 0.521
Middleclass	2/4 (50)	Urban	39/49 (79.6)	X^2 (1) = 1.8489, p = 0.174

The CPR of multiple lesions was greater in workhouse females (50% 6/12) over middleclass females (18.2% 2/11), and in urban females (63% 17/27) over workhouse females (50% 6/12). However, these differences were not statistically significant. In contrast the high CPR in urban females (63% 17/27) was significantly higher than in middleclass females (18.2% 2/11) (see highlighted in **Table 7.25** above).

Similar CPRs of between 70% and 80% were apparent in the workhouse and urban males, while the middleclass males had a lower CPR of 50% (2/4). However, none of the variations were statistically significant (see **Table 7.26**).

7.7.5 Assessment of Evidence of Healing and Active Lesions

Finally, each observed lesion of non-specific infection was recorded in terms of the level of formation, from active to healed/healing or a combination of the two. The latter would comprise active lesions being present on a bone that clearly had healed periosteal lesions also.

Table 7.27.
CPR of specific levels of healing and/or non-healing (*n*)
compared with total number of individuals with non-specific infections (*N*)

	n	***N***	**%**
Healed/healing	73	124	58.9
Active	18	124	14.5
Active and healed	33	124	26.6

The differences were statistically significant (X^2 (2) = 58.6694, p = **0.000**), indicating that almost 3/5 individuals with signs of non-specific infection were in the process of healing at the time of death.

In order to examine whether any group had a significant tendency towards any class of lesions each was compared using Pearson's chi square test. The results are detailed in **Table 7.28**.

Table 7.28.
CPRs of healed/healing lesions, active lesions, and active/healing lesions, by all individuals with periostitis, by group

Site Class	Inds with healed or healing periostitis/total inds with lesions	Inds active periostitis/total inds with lesions	Inds with active and remodelled lesions/total inds with lesions
Workhouse	19/30 (63.3)	6/30 (20)	5/30 (16.7)
Middleclass	3/7 (42.9)	2/7 (28.6)	2/7 (28.6)
Urban	51/87 (58.6)	10/87 (11.5)	26/87 (29.9)
Total	*73/124 (58.9)*	*18/124 (14.5)*	*33/124 (26.6)*

The differences were not statistically significant (X^2 (4) = 4.0041, p = 0.405), suggesting that there was no difference between any of the groups in terms of the level of healing or active lesions.

7.8 Discussion

The overall crude prevalence rate of non-specific infection in the post-medieval skeletal remains in this study was CPR 37% (124/335). Given the increase in population in this period, and the dramatic changes in both work and particularly living conditions (**Chaper 3**), it would be expected that the prevalence rate would see an increase from the medieval period. The differential recording and/or reporting of the lesions make comparisons with other sites difficult. However in a medieval cemetery excavated at St Mary's Cathedral in Tuam, Co. Galway, analysed by the writer using the same methods as the present study, the overall CPR of non-specific infection was just 10.3% (4/39) (Lynch 2005). In contrast, an overall CPR of 22.4% (117/523) was recorded in a number of medieval populations in the province of Munster (Power 1994). In Britain, a late medieval CPR of 14.1% (631/4479) was established from the combined data for 16 sites (although it did contain data from one site in Ireland) (Roberts and Cox 2003, 235). At the time of writing, the data from the European module of the Global History of Health Project, regarding periosteal lesions in the post-medieval period, were not available (Steckel 2003). Although the crude prevalence rates vary between these Irish and British populations, it is apparent that the prevalences are still lower than those established for this post-medieval study, and indicates a rise in prevalence from the medieval to the post-medieval period. This was the expected result, and conforms to the interpretation of periosteal lesions as being indicators of increased infection load in a population.

The overall CPRs was then compared with other contemporary sites, particularly those providing cumulative data. In Power's study of Munster populations she found that the prevalence rate had risen only slightly to CPR 25% (30/120) (Power 1994). While this is similar to the prevalence determined in the present study it is still lower. In Britain, the post-medieval rate from two combined sites was CPR 26.1% (52/198) (Roberts and Cox 2003, 343-344). This is very similar to the rate established for post-medieval sites in Ireland by Power, but again, is less than the present study. The differences between the present study and the British data, and the present study and the previous Munster study were statistically significant (X^2 (1) = 6.5052, p = **0.011** and X^2 (1) = 5.6963, p = **0.017**, respectively). This indicates that the overall prevalence of lesions of non-specific infection in the present study was significantly higher than other contemporary sites in both Ireland in Britain. This suggests that the combined post-medieval groups in this study were exposed to more infectious processes than some of their peers. This may be expected, given the living conditions of most of the population, combined with evidence of repeated stresses of disease epidemics and/or famines.

However, as with other aspects of this study (**Chapters 5** and **6**), it must be considered that one or more of the three groups strongly influenced the data analysis, either by having higher or lower prevalence rates. The overall prevalence rates of non-specific infection by specific group reveal an interesting pattern. The rates were quite similar in the workhouse group (CPR 44.8% 30/67) and the urban group (CPR 38.7% 87/225), while both were significantly higher that the prevalence in the middleclass group (CPR 16.3% 7/43). A similar finding was apparent when only the limb bones were considered. In reality, the workhouse and the urban group were in the upper levels of prevalence of non-specific infection, while the middleclass group were in the lower prevalence levels. This slightly contradicted the expectation that there would be high prevalence rates in the workhouse group and low rates in the middleclass, with the urban group coming somewhere in between. In fact, there were no significant differences between the high prevalence rates in both the workhouse and urban groups.

The low prevalence in the middleclass group (CPR 16.3% 7/43) suggests that, perhaps not surprisingly, they were not exposed to a wide variety of dangerous pathogens. Low CPRs have been recorded in other contemporary populations that were relatively well off. A very low CPR of just 1.1% (4/360) was recorded in a Quaker population from Kingston-upon-

Thames in London (Bashford et al. 2007). More similar CPRs were recorded in a population from St Luke's in Islington, with 16.9% (37/219) of individuals with periosteal lesions (Boyle et al. 2005), while a CPR of 22.9% (51/223) was recorded in individuals recovered from St Marylebone in London (Miles et al. 2008). It may be surmised that those in the middleclass would generally have had access to more food, and perhaps better quality food, than those in the lower strata of society. Certainly their overall living conditions would have been superior to many of their contemporaries. Food and shelter, and changes experienced in both, are the most influencing factors in the spread of infectious diseases. The social standing of the middleclass would have allowed them to shield themselves to a certain degree from the onslaught of infectious diseases that would have been commonly experienced by the lower classes in poor and vulnerable living conditions.

However, they certainly would not have been immune. Those in the middleclass could, and certainly did, contract a certain degree of infection. Indeed, it could also be argued that, because those in the higher social strata would have been *relatively* sheltered from the ravages visited on the poor, they had less natural immunity built up. In effect, similar numbers of individuals may have been equally affected by various infections across the social strata in post-medieval Ireland. However, if one group, for example the middleclass group in this study, had little experience of previous infections then they would naturally succumb more quickly to serious infection and death than those in a population that may have been exposed to a lifetime of pathogens. It has also been postulated that infections that leave skeletal markers may be the diseases that did not have major mortality rates (Aufderheide and Rodríguez-Martín 1998, 118). It is known that typhus certainly had a higher mortality rate among the wealthy than among the poor (Geary 1995, 83). Crucially, in terms of skeletal remains, these individuals in the middleclass group would die without any skeletal manifestations of the infectious process. Is it possible then, that the low rate in the middleclass group is actually attributable to a general inability to withstand infectious insults? Certainly this may be the case. Interestingly however, the middleclass did not show any variation from their contemporaries in the workhouse and urban groups in terms of the prevalence of healed and active lesions, and indeed also to the multiplicity of bones involved (see below). It could be expected that, if they had a lower resistance to infectious disease, then at least a lower prevalence of healed lesions should be present in that group, if not a higher prevalence of active lesions. However, this was not the case. The premise warrants a closer look at the crude prevalence rates in the workhouse and middleclass groups.

Prevalence rates of non-specific infection were similar in the workhouse group (CPR 44.8% or 30/67) and the urban group (CPR 38.7% or 87/225), and both may be considered high. There was no significant difference between the two prevalence rates. A CPR of just 6.8% (8/11) was recorded in the urban poor excavated from City Bunhill in London (Connell and Miles 2010), which would appear to be very low. In contrast a CPR of 30.4% (45/148) was recorded in the urban poor recovered from Cross Bones cemetery in London (Brickley et al. 1999). A high CPR of 60% (63/105) was recorded in the mainly sailors and marines recovered during excavations at the Royal Hospital in Greenwich in London (Boston et al. 2008), and was linked to the very harsh life-courses of those individuals. A CPR of 41% (no more data provided) was recorded in the adults and juveniles excavated from an African slave cemetery associated with a sugarcane plantation in Barbados (Shuler 2011), and again the high prevalence is linked with documentary evidence of severely compromised living conditions. A CPR of 21% (19/90) was recorded in pauper individuals from a cemetery in San Francisco associated with the Legion of Honor [*sic*] (Buzon et al. 2005). That prevalence, for urban dwellers, was comparable to similar American sites, but is lower than prevalence rates in Ireland and Britain, which is probably reflective of differential social conditions. Overall, high CPRs of non-specific infection are common in populations that were exposed to extremes in living conditions, and all the related factors. Such appears to be the case in this study, in terms of the paupers in the workhouses, and the general urban population.

The urban group in the present study would have been constantly under a barrage of infectious diseases. The living conditions in all but the most affluent parts of Cork city would have been poor, with inadequate hygiene and overcrowding encouraging the spread of pathogens (**Section 4.5.1**). However, it must also be remembered that not all of those in the urban Cork group were native, or long-term, city dwellers. In actuality they represent burials from a period of intense urbanisation in Ireland, in the eighteenth and especially the nineteenth centuries. Many of those coming into the cities would have been young, ambitious people looking for a better way of life with more opportunities. In fact, most individuals that emigrated prior to the Great Famine were skilled artisans or small farmers (Nolan 1997, 63). However, in times of stress the profile of those coming into the cities changed considerably. During the Great Famine, such was the influx of poor and diseased individuals into Cork city, men were deployed on the road into the city in order to stop the flow (Kinealy 2006, 172). It failed. Indeed, the level of poverty in Cork, even prior to the Famine, was such that three-quarters of the city's population were paupers (O'Mahony

2005b, 31). It is probable that most social crises would have brought additional people into the cities, for example during the devastating famine of 1740-41. This would only have exacerbated problems that already existed in eighteenth and nineteenth century cities that were without the benefits of modern public health and welfare schemes (Wohl 1983; Prunty 1998). It is therefore not surprising that the prevalence rates of non-specific infection were high in the urban group. Prevalence rates of infection in the ribs were significantly higher in the ribs of the urban group over their contemporaries and this is discussed further below.

The overall prevalence rate was highest in the workhouse group (CPR 44.8% 30/67), although the difference in CPRs between the workhouse and the urban group was not statistically significant. Given the historical background of the workhouse institutions (see **Section 3.3**), and therefore the life-courses of many of the individuals that died in them (that is, primarily paupers), it is perhaps not surprising that considerable evidence of infectious processes were evident on their skeletal remains. However, the very fact that the lesions are there to begin with, suggests that these individuals had possibly built up a certain level of immunity to various diseases, perhaps like their urban counterparts. Periosteal lesions, the primary evidence of infection, only manifest on the bone if an individual can withstand an infection for a long enough period. It has already been surmised that the low prevalence recorded in the middleclass group above may be due to the fact that they succumbed quickly to a disease, or that they simply did not have the same level of exposure to disease as those in the cities or in the lower classes. However, in terms of the workhouse population, those who died in the institutions would have been among the weakest and most vulnerable in society. Yet they displayed some of the highest prevalence of non-specific infection. Indeed, it may be that, despite the horrors of the workhouses during the years of the Great Famine, the workhouse, as an institution for the destitute, provided a level of care that exceeded that for paupers outside the institution, and thus allowed those individuals to survive, at least for some time, infectious insults. Certainly, as the role of the Union workhouse expanded to include significant infirmary duties, the sick and old poor would have comprised a higher proportion of the inmates (Luddy 1999; O'Connor 1995).

Ultimately, infectious disease is intimately linked with living conditions. It is apparent that the living conditions of the poor were inadequate, even by any standards of the day, in the post-medieval period. These conditions deteriorated until the mid-nineteenth century, when the cataclysmic Great Famine resulted in a sea-change in the realities of life for most individuals (see **Chapter 3**). It is also apparent that throughout those recent centuries the population of Ireland, and particularly the poor and vulnerable, were exposed to numerous disease epidemics, such as tuberculosis, smallpox, typhus, and cholera, amongst others, and other stresses including famines. The increased disease load in the skeletal remains from the medieval period through to the post-medieval period was discussed earlier. The high prevalence of non-specific infection in both the workhouse group, and particularly in the urban group suggests that, through generations of life-long exposures to physiological stresses, they had built up at least some immunity to infection (Eshed et al. 2010; Mitchell 2003a; Ó Gráda 2006a, 203).

Variations in prevalence of non-specific infection in the three groups in this study are unlikely to be related to differential access to medical care. Medical understanding of germ theory did not evolve until well into the latter half of the nineteenth century (Farmar 2004). In reality few, if any, of the individuals in the present study would have benefited from the new arrival of antibiotics in the latter half of the nineteenth century, as well as from the advances in public health issues (Wohl 1983). Interestingly, it was noted that many individuals of Irish descent that were resident in England, were notoriously reluctant to get their children vaccinated against smallpox, when the vaccine was finally developed (Brickley et al. 2006, 113). This would have been a typical reaction in the early days of both inoculation and vaccination, as suspicions of the procedures abounded. Perhaps some sections of Irish society were particularly opposed to them. However, in reality, this would not really have been an issue for any of the individuals in this study as they would have lived largely before any of the major nineteenth century advances in medicine.

Overall CPRs were also examined by sex. Male prevalence rates (CPR 45.2% 71/157) were significantly higher than female prevalence rates (CPR 30.8% 41/133). A similar bias was present when just the long bones were assessed for periosteal lesions (see **Section 7.7.3**). In addition, multiple bones with periostitis were more common in males (CPR 76.1% 54/71) than in females (56.1% 25/41). This has been a typical finding in many archaeological populations, and appears to be linked to a greater susceptibility of males to stress than females (Goodman et al. 1984). However, it is probable that social differences played a role also. Males generally were more mobile than females in the post-medieval in Ireland, and particularly in the nineteenth century when a mobile labouring class became crucial to the economy. The high labourer population of the country would have essentially gone wherever the work was available, in Ireland or also in Scotland. This mobility, and probably an associated inconsistency in shelter and food, may have made the male labourer in particular far more open to insults of infectious disease.

Interestingly, when the female and male CPRs were compared within each group, only the difference between the males (CPR 48.5% 49/101) and the females (CPR 18.2% 27/87) in the urban group was statistically significant. This suggests that the urban males were more exposed to infectious insults, as well as perhaps having a greater level of resistance to them. It is possible that this is linked with higher numbers of male adults coming into the city, either in terms of seeking work, or in times of stress. When the sexes were looked at individually (considering all bones), none of the females in any group showed a significantly higher prevalence over another group. When just the limb bones were considered, urban females showed a significantly higher prevalence (24.4% 21/86) of periosteal lesions than their workhouse or middleclass peers. In contrast, males in the workhouse and in the urban groups had significantly higher prevalence rates, both in terms of all bones and just limbs bones, than those males in the middleclass group. Again, this seems to be a reflection of the higher prevalence in males overall, and that females and males living in the urban environment, and males within the workhouse were subject to more physiological stresses than their peers in the middleclass group.

An important aspect of the study of non-specific lesions in these post-medieval populations was to assess what bones presented with lesions. When all three groups in this study were combined, the tibiae had the highest TPR (28.5%), while the ribs (TPR 16.3), the fibulae (12.6%), and the femora (TPR 12.2%), also had high prevalence rates (see **Table 7.7** and **Figure 7.1**). The lower limbs had a significantly higher prevalence (CPR 28.6% 78/273) than the upper limbs (CPR 7.2% 19/265). Interestingly, the maxilla had a very high TPR in the middleclass males, with a prevalence of 42.9% (3/7), and was linked with dental disease. The prevalence of dental caries (which, along with other dental diseases, may be one of the aetiologies behind inflammation and infection in the mouth) was high in the middleclass group, but not as high as the other groups (see **Section 6.7**). It is unusual that such a high prevalence was found in the middleclass males. While this study, amongst others, has established that periostitis of the limb bone was common, it is also apparent that the lower limbs consistently show the highest prevalence (Larsen 1997; Ortner 2003; Roberts and Manchester 1995; Steckel and Rose 2002). Indeed, a major study of European skeletons has revealed that the prevalence of lesions on the upper limbs has remained relatively static for centuries, while the prevalence of lesions in the bones of the lower limbs (in particular the tibia) have fluctuated significantly (Global History of Health Project 2009). Unfortunately, bone reports and publications vary considerably in the manner of reporting the prevalence of lesions (see **Section 7.5**) (Roberts 2000b). However, it is apparent that the tibiae and the ribs were typically the elements presenting with periostitis, hence the concentration on establishing CPRs in **Section 7.7.2.1**.

Numerous studies have indicated the high prevalence of the periosteal lesions in the tibiae (Larsen 1997; Roberts and Manchester 1995; Steckel and Rose 2002). The TPRs of periosteal lesions in the tibia were 19.8% (24/121) in the workhouse group, 7.7% (3/39) in the middleclass group, and 35.5% (94/265) in the urban group, and the differences were statistically significant (X^2 (2) = 19.0774, p = **0.000**). The CPRs for tibial periostitis was 23% (14/61) in the workhouse, 8.7% (2/23) in the middleclass, and 37.7% (55/146) in the urban group. The urban CPR was significantly higher than both the workhouse and middleclass group. The latter had the lowest prevalence rates, both in terms of TPRs and CPRs, of tibial infections. Similar prevalence rates, both in terms of TPRs and CPRs, have been recorded in other contemporary and comparable populations. In the wealthy population from St Marylebone in London the TPR of tibial periostitis was just 6.8% (21/308) (Miles et al. 2008), similar to the middleclass group in this study. The CPR of tibial periostitis in Monroe County Almshouse in New York was 38.7% (75/194) (Higgins et al. 2002, 170), while a TPR of 34.5% (67/194) was recorded for the mainly sailors and marines excavated from the Royal Hospital in Greenwich, London (Boston et al. 2008). Both prevalence rates were similar to the TPRs and CPRs in the present study for tibial periostitis in the urban and workhouse groups. This suggests that social status, at least in the post-medieval period, is intimately linked with bony lesions of periostitis, and that the lower in status an individual was, or the more compromised the living conditions, the higher the prevalence of periosteal lesions, and thus non-specific infection.

As with the general prevalence rates, both the general TPRs and CPRs of non-specific tibial infection were significantly higher in male individuals, particularly within the workhouse. When the sexes were considered separately, the females in the urban group revealed the highest prevalence (CPR) over the other females, while males in the workhouse and the urban group had significantly higher prevalence rates (CPRs) over those males in the middleclass group. Again, this highlights the fact that urban females and males, and males from the workhouse present with significantly more evidence of infectious lesions.

Ribs also commonly presented with periosteal lesions in the present study. As with the tibial lesions, both TPRs and CPRs were established for the rib lesions. It was apparent that rib lesions were particularly prevalent in the urban group. The urban TPR was 21.2% (52/245), which was significantly higher than the TRPs in both the workhouse (7% 7/100) and the middleclass (6.7% 2/30) groups (X^2 (2) = 12.7557, *p* = **0.002**). Assessment of the CPRs revealed similar data, with the urban group (37.7% 55/146) displaying significantly higher prevalence rates of the condition over those in the workhouse (23% 14/61) and middleclass (8.7% 2/23) groups. A similar pattern was evidence in the prevalence rates by sex. Both females (TPR 16.8% 16/95) and males (TPR 28% 35/125) in the urban group showed higher prevalence rates than their contemporaries. Prevalence rates in the other groups were all under 10% in both sexes, with none of the females in the middleclass presenting with the lesions. Interestingly, within the urban group, males had a significantly higher CPR (36.8% 25/68) than the females (20.4% 11/54). Again, as with the general prevalence rates of non-specific infection, urban males appear to have been considerably at risk of periosteal lesions on the ribs. Rib lesions were evident in just CPR 4% (9/223) of the adults from the wealthy post-medieval cemetery at St Marylebone in London (Miles et al. 2008). In contrast, visceral lesions were present on CPR 28.8% (26/90) of the sailors and marines from the Royal Marine Hospital in Greenwich in London (Boston et al. 2008). Both the TPRs and the CPRs of rib lesions in the present study suggests that the urban environment of the post-medieval period may have been particularly harsh on the respiratory system.

There is little doubt that periosteal rib lesions may be related to tuberculosis or TB (Roberts et al. 1994; Santos and Roberts 2001). Tuberculosis was the one of the primary causes of death in Ireland in the nineteenth century (Jones 1999). The 1841 census calculated that 135,590 people had died from TB in the previous 10 years, compared with 23,518 fever deaths (ibid.). Certainly, some probable cases of TB have been identified in the populations in the present study (see **Chapter 4**). However, pleural lesions can occur as a result of any pulmonary infection. Periosteal lesions in the ribs of a number of the victims of Vesuvius (AD79) recovered from the beach at Herculaneum in Italy, have been linked with indoor air pollution (Capasso 2000). While it is apparent that many of those in eighteenth and nineteenth century Cork may have been rural dwellers relatively recently arrived to the city, it is possible that the environmental conditions of the city contributed immediately to pulmonary infections. Irish cities, apart from Belfast, never really encountered the problems of the industrialised Victorian cities of Britain, primarily due to the lack of comparable industrialisation. However, there were inherent urban problems (Wohl 1983; Rynne 2006). The urban poor of Dublin in particular, but also in Cork and Limerick (in contrast to Belfast) ultimately lived in perhaps even more abject poverty than their rural counterparts (O'Connell 2007, 2; Prunty 1998). This is despite the fact that Ireland in the nineteenth century was still mainly a rural economy, with most people living in the country. According to the 1841 census 47% of the population were occupied in agriculture, compared with 28% in industry (Rynne 2006, 3). This was almost the reverse of contemporary Britain where just 22% were in agriculture compared with 41% in industry (ibid.). That same census also records that over 80% of the population lived in dwellings that were classed as third and fourth class (O'Connell 2007, 4). Fourth class houses comprised mud cabins of just one room, while third class houses were still built of mud, but varied between two to four rooms, and had windows (ibid.). Ventilation would have been a serious problem in many of these structures. The prominence of the lesions in the urban males over the urban females, suggests again that the males in particular in this group, may have been subject to significant physiological stresses. While these are undoubtedly related to the conditions of the general populace in the urban environment it is also probably linked to difference work practices and occupational hazards.

The multiplicity of lesions in individuals was also considered. Lesions that occur in multiple locations on a single individual have been interpreted as being indicative of systemic infection (Larsen 1997, 83; Shuler 2011, 72). In total CPR 65.3% (81/124) of individuals with lesions of non-specific infection had more than one bone affected. No group displayed a higher prevalence over another in terms of CPR. The prevalence of multiple lesions in the marines and sailors (and a few females) from the Royal Hospital in Greenwich in London was 50.8% (53/105) (Boston et al. 2008, 45-46), and this high prevalence was linked with the difficult life-courses of these individuals. A total of 47% of juveniles and adults from the Newtown slave plantation in Barbados had multiple lesions (Shuler 2011). When overall female and male prevalence rates were compared, males had a significantly higher CPR (76.1% 54/71) than females (CPR 56.1% 23/41). This links with earlier evidence that males had significantly higher prevalence rates of non-specific infection than females. Only the females in the urban group (CPR 63% 17/27) had a significantly higher prevalence of multiple lesions over females in the middleclass (CPR 18.2% 2/11). This again confirms that males generally had higher prevalences of infection, and the urban individuals were typically significantly affected, as were the workhouse individuals. It also suggests that males may have been more affected by systemic infections than females.

Finally, interesting data is also apparent from the assessment of healed and active lesions. Just CPR 14.5% (18/124) of all individuals with infectious lesions had exclusively active lesions at the time of death. Just over CPR 85% (106/124) had evidence of healed or healing lesions at the time of death. Somewhat surprisingly, as with the evidence of multiple lesions, no group showed a significantly higher prevalence for active or healed lesions. Crucially, those infections that are represented by systemic periostitis are probably the diseases that had a more subtle demographic impact than acute infections (Aufderheide and Rodríguez-Martín 1998, 118). In reality, the infections that lead to bony lesions may not necessarily be the cause of death (Ortner 2003, 181). This may be precisely what is apparent in these groups. The similarity between the multiplicity of lesions and the evidence of healing between the three groups is also likely to be related to the complete lack of any medical care in the modern sense of the word. There simply were no cures for the many ills that individuals in the eighteenth and nineteenth centuries endured. While wealth may have provided a more stable and safe existence than poverty, it could not buy a cure that did not exist. No group had that advantage over another. The overall high prevalence rates in the workhouse and urban groups are unlikely to be the diseases that actually claimed their lives. This is related both to the fact that they clearly survived long enough for the lesions to appear, and the majority of individuals had evidence of healing. However, it cannot be doubted that these infections could have been very stressful on the individual, and may have played a part in contributing to eventual decline and death.

With infection, death was perhaps not always the worst outcome. Many diseases could be extremely debilitating, particularly on the impoverished. When a poor individual contracted a fever, the rest of the household were typically stricken down also. This was in contrast to those in better living conditions, where infection was typically confined to the original host (Kennedy et al. 1999, 118). While fevers could obviously kill, they held other dangers too. Due to the recurring nature of some infections, a family could be stricken with a disease for months. Even without death, an infection could debilitate the breadwinner of a family, thus ultimately pushing a family quickly over the edge into utter destitution (Geary 1995). The pattern, once established, was cyclical and devastating. Those who are suffering under/malnourishment are more susceptible to disease, which in turn makes them even weaker (Larsen 1997, 88; Wohl 1983). In desperation people moved in search of relief, which both destroyed the existing social order and caused severe problems further afield as the unfortunates often crowded into cities. The public health efforts in the nineteenth century gradually began to cope with the unique problems that significant population increases brought, with sanitation being perhaps the single most important factor (Wohl 1983).

The osteological paradox (**Section 2.5.1**) puts forth the supposition that the dead in a cemetery are biased and cannot represent the living host population that did not die. As such, for example, an individual with periostitis may actually represent a healthy individual, with the physical well-being to withstand a disease process. The weak would die with no skeletal manifestation of the disease. While the argument is certainly valid, this study, along with others referred to earlier (**Section 7.5**), confirm the traditional interpretations of these markers of stress. It is evident that the disease load increased from the medieval period through to the post-medieval period on the Irish population. This is entirely reflective of the changes, and particularly deteriorations, in social conditions that occurred in those periods. However, the load was not evenly distributed. Like many of their contemporaries in the same social class, those in the middleclass had the least evidence of infectious disease. In reality this is probably a conflicting combination of less exposure to infectious insults and a general inability to combat them, linking in with the paradoxical approach and the normative approach to the interpretation of these lesions (see **Section 2.5.1**) (Jackes 1993, 434; Wright and Yoder 2003, 57). In contrast, the high prevalences in both the workhouse and urban group are probably an indication of both an actual increase in the exposure to disease and an increased ability to withstand that disease. In essence, the high prevalences may be an indication of Seyles adaptive coping (Selye 1976a, 54) (see **Section 2.4.1**), where individuals adapt to cope with stress, but essentially carry on, without necessarily suffering any further issues. While, medicine clearly could offer no group an advantage over another, socio-economic status ultimately determined the level of exposure to infections and physiological stresses, which has translated into the skeletal remains of these individuals. The prevalence rates are ultimately a reflection both of the hazards that those in the workhouse and urban groups were exposed to and also the resilience of the human body.

The next, and final, chapter (**Chapter 8**) will discuss the results of the analysis of the health markers in terms of the overall research agenda of this study.

CHAPTER 8:
Discussion and Conclusions

8.1 Synthesis of Analysis

Human skeletal remains are moulded by the life-course of an individual (Gilchrist 2000; Sofaer 2006). The 'slings and arrows' of life may leave markers on the skeleton that are testament to the environment in which an individual lived and ultimately died. Analysis of the markers of deprivation may inform on past societies, even when there are apparently endless written records. Three groups, all dating to the later half of the post-medieval period in Ireland, were selected for study in order to assess the physical impact of socio-economic inequality in the Irish population of the eighteenth and nineteenth centuries. One of the groups was from Poor Law Union workhouses, and primarily represents paupers, the poorest individuals in society. Their physical well-being would have been compromised from birth, but it was the crisis of the Great Famine that struck them, and the cottier and labourer class from which most paupers were drawn, the hardest. The second group was represented by a selection of small skeletal samples from Church of Ireland and Quaker cemeteries. The supposition was that these individuals broadly represent the middleclass of Ireland. While it is unlikely that all of those individuals were wealthy, it is equally unlikely that there were significant numbers of poor buried within those cemeteries. Finally, another group represented an urban group from Cork city, primarily from the nineteenth century. While many of these would have represented migrants from the rural hinterland of Cork, many would also have lived their lives within the environs of the typically squalid conditions of the nineteenth century city. It may be expected that there are also some individuals of wealth in that cemetery sample. Three particular avenues of research were explored in the present study. These included an assessment of stature and femur length, an examination of prevalence rates of caries and ante-mortem tooth loss (AMTL), and a study of the prevalence of periosteal lesions in the skeletal remains. Each of these has been examined in detail in the preceding chapters (**Chapters 5**, **6**, and **7**). However, a synthesis of the results of those analyses will be presented here.

There is a clear and established link between stature and socio-economic status (Bogin 1988). The present study found a general decline in male statures between the medieval and the post-medieval period, while the female statures appeared to have remained relatively static. It is known that living conditions declined in that period which would account for the decline in male statures. The lack of change in females may be related to variations in the response of females and males to physiological stress. The average female stature was shorter in comparison to their contemporaries in Britain. In terms of the female statures across the three post-medieval groups, there were no variations, although the femur length of workhouse females was significantly shorter than the other two groups. However, when the stature of the females were compared with contemporaries outside Ireland, particularly in Britain, it was found that both the workhouse and urban females were significantly smaller while the middleclass females were either comparable or taller. The overall average male stature was again shorter than their contemporaries in Britain. Between the males in the three groups, in contrast to the females, the workhouse males were significantly shorter than their counterparts in the middleclass and urban groups, but there was no difference in femur length. As with the females, the workhouse males were shorter than the poor in Britain, while the middleclass males were again either comparable or taller. In contrast to the females, the urban males in Ireland were shorter than males in urban areas in Britain. In general, the short statures of both the female and male paupers contradict traditional research, from both contemporary observers and modern analysis of stature records, which have shown that the Irish poor were noticeably tall in comparison to their British counterparts in the post-medieval period. This may be related to the fact that those paupers were, in reality, the most vulnerable within their group and may not be actually representative of the general poor in Ireland in the nineteenth century.

Assessment of the prevalence of caries and ante-mortem tooth loss revealed a number of important factors. There was an increase in the prevalence of caries from the medieval into the post-medieval periods. This was entirely expected, given the changes in foodstuffs that occurred in the period, in particular with the increasing availability of sugar and refined carbohydrates. The prevalence of the disease was also higher than the prevalence in contemporary Britain, despite the fact that the latter had a much higher level of sugar consumption. The prevalence of the disease was significantly higher in the workhouse group, where rates were similar, or higher, than prevalence rates of other samples of poor and paupers both in Britain and the United States. The prevalence rates in the middleclass and urban group were comparable to other similar communities outside Ireland. The prevalence of the disease in the middleclass group especially, but also in the urban group, was likely to be related to the increase of sugar and refined carbohydrates in the diet. The middleclass, by reason of money, would have had access to such foodstuffs, and there was certainly an increase in sugar consumption in the nineteenth century. Some in the urban group would have been able to afford such food, but they would also have had increased access to more exotic foodstuffs than those in rural areas by virtue of their location within a port city. The very high prevalence in the workhouse groups was an indication of a highly cariogenic diet. Sugar and refined flours would have been negligible in the diet of the poor. In reality, the carious lesions in that group were probably related to a diet that was extremely high in potatoes, as well as refined maize meal. No significant differences were apparent in the prevalence of caries between the sexes across the groups. However, the prevalence of ante-mortem tooth loss by observable socket was significantly higher in the females in all three groups. Females in the workhouses were particularly affected. While male prevalences of AMTL were lower, there were still significant differences between the three groups, with the highest prevalence being in the workhouse, the lowest in the middleclass groups, and the urban group in between. The significance of AMTL was highlighted by the fact that 15% of the workhouse group were edentulous, compared to 5% of the urban group. None were identified in the middleclass groups. The high prevalence of AMTL was likely to have caused the underestimation of caries across all three groups.

Periosteal lesions were examined on the basis that they are indicators of non-specific infection. This study revealed a rise in periosteal lesions from the medieval through to the post-medieval period. This was as expected, given the decline in the general standards of living in the period. The overall crude prevalence rate (CPR) was also higher than that recorded in Britain. Given the industrialised and urbanised nature of Britain in the late eighteenth and nineteenth century and the comparatively agricultural and rural structure of Ireland, it may have been expected that the prevalence in the Irish group would have been lower. Indeed, the 'urban penalty' of higher disease rates, lower life expectancies, and lower height is a well-recognised phenomenon (Baten 2009). However, the Irish poor appear to have suffered more significantly than their British counterparts. When the three groups were considered separately, there were significantly higher prevalence rates in the workhouse and urban groups in comparison to a relatively low prevalence in the middleclass group. While it is beyond doubt that those in the workhouse would have endured significant stress and infectious assaults, the urban group also appeared to have suffered significantly, presumably because of the prevailing conditions in nineteenth century urban Cork, as in other Irish cities. Males exhibited higher prevalence rates over females, and the manifestation of the periosteal lesions was more severe, with more males presenting with multiple lesions. Males generally appear to have a higher susceptibility to stress, and this may also be linked with the general mobility of males in the period, particularly in terms of travelling for work. Within the groups however, only the difference between the females and the males in the urban group was significant, with more than twice as many males presenting with the lesions than females. Almost two-thirds of all individuals affected had more than one periosteal lesion, and the prevalence was higher in males. As is typical with many archaeological skeletal samples, the lesions were most prevalent in the tibiae and the ribs. Both of those locations had a higher true prevalence rate (TPR) in the urban group. This may be a reflection of the crowded unhygienic urban environment of the city in that period. Interestingly, there was no variation in the multiplicity of lesions between the groups. Similarly, there were no group differences in terms of evidence of healing. The latter was common, with 85% of individuals showing some indication of healing. Thus while the prevalence rates differed between the groups, it appeared that the actual experience of the lesions was similar throughout. This was likely a reflection of the lack of influence of actual modern medicine in the samples: no group had advantage over the other in terms of access to antibiotics, simply because the latter did not exist.

8.2 Discussion

Every human individual has a preordained sequence of growth, from conception through to death. However, this pattern of development and growth is intimately related to the environment in which an individual is born into, is raised in, and lives, works, and dies in. Typically in the pre-modern era in Ireland, an individual was essentially born into the 'class' in which they would die. Certainly, the circumstances of a family may change through the generations. However, in reality it was only when wider socio-economic circumstances changed, and there was an advance in medical knowledge, that there was really an improvement in the lives of the poor. Reference was made above to the plasticity of the human body, and to its sensitivity to the environment (**Section 2.3**) (Gilchrist 2000; Sofaer 2006; Worthman and Costello 2009). The human form is intimately related to the circumstances that an individual experiences throughout their life. The three main areas of health status that this study examined (**Chapters 5**, **6**, and **7**), have established clear variations between the socio-economic groups in terms of the effects of their living conditions on their physical bodies. It is evident that the socio-economic status of an individual in the latter part of the post-medieval period intimately influenced the physical body.

Clear variations were in evidence in terms of stature between the three groups. Differences between females and males are likely to have been related to both the different life experiences of both, and of basic physiological variations. Overall however, it was evident that those who died in the workhouses were short in stature, which suggests their difficult life-courses ensured that they could not develop to their full potential. Could this be a case of Selye's 'adaptive coping' (see **Section 2.4.1**), where the diminishing stature was a successful coping method to the strains of a life in abject poverty (Selye 1976a, 54)? Essentially, the answer would be no, simply on the basis that these are the dead of that pauper class and, in terms of the osteological paradox (Wood et al. 1992), the weakest of the group. Their short stature was as a result of poor conditions in life, which ultimately lead them to a grave within the workhouse. There are numerous contemporary records of the general good health of the Irish poor in the eighteenth and nineteenth century, despite their abject poverty (Clarkson and Crawford 2001, 224). This has been confirmed to a certain extent by economic historians, particularly in comparison to British data (see **Section 5.5**).

However, the paupers in this study may not actually be necessarily representative of the poor classes as a whole and, as such, represent a distinct sub-set of the poor. This certainly appears to be reflected in their skeletal remains. Perhaps shortened stature did indeed lead to a premature death. If those in the workhouse cemeteries are significantly shorter than both their contemporaries at home and to comparable populations aboard, then this would suggest that the shortest individuals were indeed the most affected by physiological stresses and ultimately death. Thus, within the context of the poor and pauper class, short stature may indeed have been hazardous to life. Short stature is essentially an adaptation to stresses in childhood, but in the context of the poor of Ireland it appears to have been maladaptive coping, ultimately defining a life of physical strain ending in death in a workhouse. This perhaps explains why the skeletal evidence does not tally with the extensive evidence on the tall statures of the Irish poor in contemporary records. The dead in the workhouse represent the very extreme of the poor classes, not those that enrolled (either through choice or through force) in the British army and navy, and possibly not even the convicts and indentured servants, all from whom the tall and healthy Irish poor image is based on. The workhouse dead were physically at the very lowest rung of society. In contrast, those in the middleclasses in particular were comparable to their contemporaries in Britain at least. This trait appears to have continued on for generations, with a study in the 1930s noting that Irish Church of Ireland individuals were taller than Irish Catholics, but that the tallest of all were the Presbyterians (Hooton and Dupertuis 1955, 128).

In terms of the carious lesions and ante-mortem tooth loss (AMTL), again it is likely that the extreme nature of the workhouse group have dominated the results. There were high prevalence rates of caries across the three groups, but the prevalence in the workhouse group was very high. This is despite that fact that sugar in particular, played a very small part in the Irish diet until the end of the nineteenth century, unlike Britain. Yet the prevalence rates of caries were higher in Ireland, and were especially high in the workhouse group, who clearly would have had no access to sugar at all. Even in their lives before entering the workhouse, sugar did not form a significant element in the diet of the poor (**Section 3.3.1**). In reality it was the sheer quantity of potatoes, combined perhaps with the consumption of processed Indian maize meal, that allowed the development of such a high level of carious lesions. The aetiology of caries in the other groups is likely to at least relate to some degree to sugar and refined carbohydrates in the diet, particularly within the middleclass group. The findings certainly contradict traditional modern clinical teaching that serious caries is as a result of the sugar-filled foods of the twentieth century (see **Section 6.3**). Given the results of other osteoarchaeological studies however, it is perhaps not surprising to see high prevalence rates in late post-medieval populations, even if those high rates vary between contemporary groups. What is crucial here is the understanding that it is likely that the aetiology of the lesions in the groups differ. This has implications for the interpretation of caries prevalences in populations where perhaps significant contextual information may not be available, and warns against blanket interpretations. Prevalences of AMTL suggest that the even the high prevalence rates of caries were an underestimate.

The assessment of the periosteal lesions revealed a number of interesting results. This study proceeded with the generally accepted premise that periosteal lesions are related to non-specific infection within a population. However, the osteological paradox quite rightly questions whether the actual presence of these lesions are a reflection of the health or ill-health of an individual (Wood et al. 1992). Are those that present with the lesions the ones healthy enough to survive long enough for the lesions to appear, and do the weakest simply die before the lesions can manifest skeletally? The most ready way to address this issue was to examine populations with sound contextual evidence as to socio-economic background in particular. The prevalence rate of these lesions in Ireland increased from the medieval through to the post-medieval period. This relates to the increase in social stresses in that period (**Chapter 3**). In terms of the three groups, the prevalence rates were higher than those in Britain in the same period. While Britain did not suffer a famine at the scale of the Great Famine in Ireland in the latter part of the post-medieval period, there were certainly still problems especially associated with urbanisation and industrialisation. However, the lesions were particularly prevalent in those groups from the workhouses in Ireland and in the urban group. The social circumstances of these individuals have been well documented, and they would have been subject to repeated episodes of numerous infectious diseases throughout their lives. The high prevalence of the lesions in these groups conforms to the traditional interpretation of these groups being under significant pressure with the onslaught of infectious diseases. Urban living appeared to be particularly hazardous in terms of lung infections, with high prevalence rates present in that group. This is an indication of the different physiological stresses that even contemporary populations may face, and that without proper contextual information, the interpretation may be compromised.

Interestingly, the lack of modern medical intervention appears to have been the same across the groups, whether rich or poor. The fact that 85% of individuals with the lesions showed some level of healing at the time of death, suggests both a certain resilience and that perhaps it was the infections with lower mortalities that allowed the lesions to develop in the first instance. In addition, the high prevalence of the lesions and the high level of healing at the time of death are reminiscent of Seyle's theory of active coping in terms of stress (see **Section 2.4.1**) (Selye 1976a, 54). Clearly these individuals suffered frequent assaults in terms of infectious disease, but the severity of those infections may have been at the milder end of the scale. The bodies of even the poorest, most wretched pauper was apparently able to cope with those stresses as ably as an individual higher up on the socio-economic ladder. In effect, these individuals may still have died from a more heavy-grade infection, despite having survived perhaps many years of other infectious diseases.

Variations were also apparent in the data in terms of the sex of the individuals. Females, in general, appear to have suffered less in terms of skeletal indicators of stress than males, with less variation in their statures, and a lower prevalence of non-specific infection. However, in terms in particular of AMTL, females showed a very marked higher prevalence than male individuals. In all instances, normal physiological variations between females and males, may be cited to account for the variation in results between the sexes. However, certainly females and males may have been exposed to differing physiological threats throughout their lifetimes. Women traditionally may be seen as more economically vulnerable than men in terms of late post-medieval society, with fewer employment opportunities (Grauer et al. 1998, 155). There were few occupations that a woman could legitimately make a living from, and many women were invariably reliant on the support of men. The cottage industries were a particular mainstay of poor women, but this avenue of support all but dried up with the onset of Ireland's fledging industrial revolution (see **Section 3.2**). The women that relied on these cottage industries effectively disappeared from the record (Gray 2010). In reality, many would have finally ended up in the workhouse. Once a woman was in a workhouse, she was more likely to spend the rest of her life in there than a man (Grauer et al. 1998). While socio-economic status appears to have had by far the greatest influence on the physical body of individuals in the period in question, the sex of the individual was also a crucial factor. However, it does appear that while women would have been more vulnerable to shock overall, in terms of basic physiology, they may have had a greater capacity to cope than their male counterparts. In contrast, the general condition of the dentitions of females indicates that their diets in later life may have been significantly compromised in comparison to males.

One of the primary hypotheses of this study was to test if some of the traditionally recognised indicators of stress in human skeletal remains – namely, stature, carious lesions and AMTL, and non-specific infection – are indeed representative of the health status of a population. The results indicate overwhelmingly that indeed these indicators do reveal invaluable data on the health status of population groups. The latter half of the post-medieval period in Ireland was a time of increasing stress, whether in terms of changes to foods, increases in, and emergence of new, diseases, and changes to living and working conditions. The manifestations of the selected markers in the overall skeletal sample are broadly reflective of the stresses of the period, an indication that the Ireland of the eighteenth and nineteenth century was not a healthy environment, in comparison to Britain. This study also highlights however, how the interpretation of such markers is substantially enriched by contextual information, and that the more background is available, the more detailed the interpretation may be. The body, and therefore the skeleton, is moulded by the experiences of life (Mascie-Taylor and Bogin 2005). The manner in which it reacts to positive or negative influences is dependant on a myriad of factors, which not only include the manner of development in the formative years of childhood, but also to changes in circumstances in adult life. Crucially, it must be acknowledged that different contemporary socio-economic groups may be under different physiological stresses and also may have different reactions to the same stress. For example, an increase in stress markers in one group may occur as a result of its members naturally developing a higher tolerance to stress (paradoxical interpretation), while a similar increase in another group may be an indication of an actual increased level of stress (normative interpretation) (Jackes 1993, 434; Wright and Yoder 2003, 57). Indeed, a combination of the two may also be possible. In reality, it is difficult in any study to determine which, if either, may be the case. This factor of adaptability is crucial in the interpretation of skeletal remains. Contextual data may inform on the manner in which to interpret the analysis of those remains. The variations (and the findings primarily relate to variations rather than similarities) in the results of the examination of the health status of the three population groups in this study are where the real nuances emerge.

The health variations seen in this study are almost exclusively reflective of socio-economic variations between the groups. As expected, the workhouse group revealed the most compromised health, the middleclass the least, with the urban group somewhere in between (interestingly, the latter group were typically more comparable to the workhouse group, suggestive of the hazards of urban life, despite any wealth advantages some may have had). This agrees with the traditional interpretation of skeletal health indicators as being representative of the health status of a population, in contrast to one of the primary suppositions of Wood *et al* (1992). This study was never intended to assess regional differences between the groups. In any case, most of the samples were too small to stand alone statistically. However, the data from combined samples of equal socio-economic status indicate real and substantial variations between the health statuses of those who lived in poverty and those who had at least some income. It is evident that each group, within their own broadly similar environs, would have experienced very different life-courses to the other groups. Some may have been subject to different levels of stresses, whether in terms of the prevalence of disease or the compromise (or not) in diet. For example, the sudden disappearance of the potato from the diet of the poor had fatally devastating consequences, while the effects of such in the middleclass group was likely a simple lack of just another food in an otherwise varied diet. Crucially, those within the lower strata of society, such as the cottiers, labourers, and paupers in rural areas, and the poor within the urban contexts, lived life in a very delicate balance, and they were particularly exposed to crashes within their systems. While certainly some regions, such as the west of Ireland, suffered worse that other parts, in reality the Great Famine should be considered in socio-economic terms. Any perusal of contemporary records of the period, such as any surviving workhouse minute books, or coroners' reports, highlight repeatedly the fact that people, or families, could be literally dying at the side of the road, while their better-off neighbour carried on with life as normal (McGoff-McCann 2003). As mentioned earlier (**Section 2.6.1**), class is 'a structural phenomenon defined by the relationship of a social group to the means of production' (McGuire 2008, 102). The cottiers and labourers rapidly lost their relationship to the means of the production when the Great Famine hit, and they rapidly descended into the reviled destitute classes.

It could actually be argued that those within the workhouse sample in particular represent such an extreme of poverty that they are not in fact representative of the general poor of the period. It is evident from historical documents that those who entered the workhouses were typically the most vulnerable in society. Indeed, both workhouse cemeteries in this study revealed individuals who may have had significant physical and mental disabilities (see **Sections 4.3.1.2** and **4.3.2.2**), factors which have also been identified in at least one other workhouse population since the completion of this study (Lynch 2012b). All of the results of the analysis from the workhouse group in this study were extreme: from the shortened stature, to the level of tooth loss and decay, to the manifestation of non-specific infection. In reality, those in the workhouse cemeteries represent the weakest of the poor. As such, while they may not perhaps be representative of the general poor, they are certainly representative of the estimated one million people that died in the Great Famine. Some of those were paupers for all of their lives; others were cottiers and labourers, driven into destitution by the events of the Great Famine. The actual biological effects of the Great Famine on the survivors are lost within the multitudes of parish cemeteries around the country. The circumstances that led to the expansion of the population of poor have been extensively examined (**Chapter 3**), and were inextricably linked with British involvement in Ireland. British policy allowed, encouraged, and indeed demanded, the development of a huge agriculturally-based population, who increasingly relied on the potato for exclusive sustenance. In reality, the physical makeup of the paupers, the rural cottiers and labourers, and the poor in the urban centres, was, by the onset on the Great Famine, already shaped by the preceding decades of repeated food shortages and disease onslaughts.

Under the 1801 Acts of Union, Ireland and Britain were considered, by law, to comprise a single united country. But were the poor in Ireland treated any different to the poor in Britain? Certainly, there were vehement opponents, both in Ireland and Britain, to the British workhouse system being copied into Ireland in the 1830s (**Section 3.3.3**). It has also been suggested that the Irish Poor Law Act of 1838 was actually harsher towards individuals than its equivalent in Britain, because of the belief that a more liberal system would drain Ireland's resources (Kinealy 1995, 106). In addition, the vast majority of Irish tenants were essentially living in a feudal economy, while their English counterparts at least, were protected by Common Law (Slater and McDonagh 1994). Thus, despite being considered British citizens, the Irish poor were treated differently to their British counterparts. To a certain degree the Victorians had a fatalistic attitude: people got sick and died, and nothing could prevent it (Wohl 1983, 18). While it may be surmised that the workhouse was ultimately to alleviate poverty, in reality, the penitential regulations highlighted that the workhouse was to punish the poor for their sin of poverty. The reality in Ireland was that much of that poverty was as a direct result of centuries of British government policies. Unlike Britain, the poor in Ireland were not victims of industrialisation, but rather victims of the lack of it (Prunty 1998), and 'Ireland's experience in the first half of the nineteenth century serves as a grim reminder of the cost of failing to industrialise' (Mokyr 1983, 276).

But Britain did not require Ireland to be highly industrialised. Ireland was required to have a high agricultural output, in order to supply the industrial workers of Britain, as well as the British army and navy. This is precisely why, on the eve of the Great Famine, there was an enormous population of poor agricultural workers in Ireland. When shocks came into their delicately balanced world, the support system comprised a regime that was deliberately harsher than the equivalent in Britain, despite the 'union' of Ireland and Britain. It has been shown that there were clear variations between the skeletal indicators of health in the various socio-economic groups in this study. Those socio-economic groups developed specifically as a result of British control in Ireland, both before and after the Acts of Union and, as a result, British policy helped to define the physical bodies of the inhabitants of Ireland. The variation between the Irish skeletal evidence of health and the British data indicate that the Irish poor in particular suffered significantly because of this. It has been shown that the physical development of slaves was ultimately controlled by their masters in antebellum United States (see **Section 5.4**). Clearly the British government did not exercise such control over the Irish masses. However, the effects of Ireland's relations with

Britain ensured that a huge proportion of the population were very physically compromised, more so than the poor in Britain at the time.

It must be stressed that the divide between the rich and the poor was not necessarily related to religion, although it is beyond question that the vast majority of the poor cottier and labouring classes in Ireland were Catholic. However, it was not as simplistic as the poor Catholic and the affluent Protestant (Cronin 2010). There were variations. Certainly the numbers of Protestants varied from county to county. In 1732 Catholics accounted for 89% of the households in Co. Cork. In contrast just 46% of the houses in Co. Fermanagh belonged to Catholics (Barnard 2009, 283). However, interestingly, at least in eighteenth century Ireland, only about 5% of the total Protestant population comprised freeholders and freemen. Many of the Protestants in Ireland would actually have been quite poor. As such, most of the conforming Protestants, with little wealth, comprise a 'hidden Ireland', just as the Catholics and Presbyterians did (Barnard 2003, 20). The Catholic poor, both in Ireland, and when they emigrated to both England and America, were at least afforded attention by contemporary commentators. The latter did make the occasional reference to the Protestant poor, such as in Roscarbery where, in 1786, the Rev. S. Jervois bequeathed £400, the interest which was to be divided annually between the Protestant poor of the town (Lewis 1837b, 536). However, in reality, the identities of Protestants who lived in poverty appear to have been concealed by the sheer numbers of Catholic poor.

Following on from this concept of hidden people within this period, Sofaer (2006, 44; referring to Gell 1998) has argued that the 'biological careers' of people may continue after death through memories and material objects. This may be considered to be true of those buried in defined cemeteries that may still be in use, such as some of the middleclass cemeteries in this study. However, ironically it may also be suggested that it is the individuals buried in those cemeteries that perhaps are the most anonymous in terms of the osteoarchaeological story. There is a considerable volume of written sources relating to those who went into the workhouses, but the masses that eked out an existence in, for example, eighteenth and nineteenth century Cork city remain particularly out of reach. Those urban cemeteries may have in use for perhaps up to a couple of hundred years, and are likely to represent a number of strands of society. In contrast, both the formal workhouse cemeteries and/or burials associated with the workhouses, comprise distinct groups of individuals. In effect, if the poor in workhouses were considered the 'invisible people' by their contemporaries (Grauer et al. 1998, 150), they are now, somewhat ironically, *more* visible due to their distinct burial locations.

The actual location of many of the burial grounds was specifically linked to the non-status of the pauper (see **Section 2.6.4**). The location of the Manorhamilton burials, though not marked on the ground, was easily identified once research began, primarily due to the regimented design of the institution. In contrast, the Cashel burials were completely unexpected when rediscovered during recent works on the site. There were simply no records of the burials. Similarly, it could only be surmised that unmarked mass pit burials from Borrisokane in Co. Tipperary, were associated with any one of the nine auxiliary workhouses and/or fever hospital that were in the immediate vicinity (Lynch 2009). Recent works at the location of Nenagh workhouse, now the location of the Mid-Western Hospital and which were not subject to archaeological monitoring, also unearthed unmarked burials associated with the workhouse (McKinstrey 2012; Lynch 2012a), while similar circumstances prevailed on the discovery of almost 50 burials associated with Tuam workhouse in Co. Galway (Lynch 2012b). It seems that it was only the designated burial grounds *outside* of the workhouse grounds that have remained in the public knowledge, simply by virtue that they were not hidden by the enclosing walls of the workhouse. Those buried within the high enclosing walls of the institutions were largely forgotten, and their skeletons, even today, are often only afforded proper archaeological protection in retrospect. Essentially, these paupers were to be hidden and forgotten during their lives, and also if they died in such circumstances (see **Section 2.6.4**). Despite the back-patting that was prevalent in Ireland during the 150th anniversary of the Great Famine in terms of the levels of commemoration, it is evident that the physical remains of the dead of the workhouses are still largely forgotten (Garman and Russo 1999). The evidence of the use of the pauper dead for medical learning is also reflective of the perceived status of the poor by those with means. As the pauper had suffered a social death on entering the workhouses, they also died alone. Their burial location would not be visited, and so their burial places could be legitimately erased from memory.

The concept of invisibility is important in terms of the present study. Women and children have been referenced in other studies in terms of social invisibility (Teelucksingh 2006; Shuler 2011). Entry into the workhouse was akin to a 'social death' (Hubert 2000). The poor were criminalised, locked away until they were no longer a burden on society (Spencer-Wood 2009). Social ties were typically lacking when people opted to go into the workhouses (Grauer et al. 1998). Death within the workhouse meant the pauper was still a burden on society even then, with the onus of burial on the Union. Paupers may not have been the 'dead without status' that warranted burial in *cillíní*, the unconsecrated burial grounds that were the resting places for unbaptised infants, suicides, and strangers, amongst others (Murphy 2011; Pentikäinen 1989), but they certainly were not considered the same as those in 'civilised' society. 'Where to put the remains of the dead is generally not a matter of functional expediency. The place of the dead in any society will have significant and powerful connotations within people's perceived social geographies' (Parker Pearson 1999, 141). This factor of the loss of identity of the pauper and their burial place within the workhouse was in contrast to most of the middleclass cemeteries and the urban cemetery in this study. Most of those sites retained their boundary definitions and their identification as actual places of burial to this day. The separation of the living and the dead is a universal feature across many societies and time periods (Parker Pearson 1999, 25). The fact that, at least in the early years of the workhouse, the pauper dead were confined to the same enclosing walls as the living was related to how those individuals were viewed in life. It was important that the workhouse dead were kept separate from both the living and the dead in normal society, but it did not matter that the dead pauper was intimately associated with the living pauper by virtue of the enclosing walls. It did not matter because the pauper did not matter. Unlike their counterparts in the middleclass and urban cemeteries, there was no 'power of the ancestors' associated with the pauper dead (Parker Pearson 1999, 26). There were no lamenting mourners for the dead pauper, and no one would mark the grave with a headstone commemorating them. The dead pauper was essentially forgotten, certainly by the community on entering the workhouse, and by all in death.

Whether the pauper was a homeless beggar, or a cottier or a labourer from a small, one-roomed cabin, it is difficult to imagine just how daunting the structure of the workhouse was to a poor person. Although many of the workhouses have been either demolished or refurbished beyond all recognition, enough thankfully remain that the modern observer can get some sense of how these institutions actually appeared. In contrast, the one-roomed 'cabins' of the majority of the poor of the nineteenth century have no real tangible presence in the Irish landscape anymore. The hovels, that were the dwelling places of between 3 and 3.5 million people on the eve of the famine, are gone. All that remain are the accounts, such as this from William Cobbett, a journalist travelling in Ireland in the first quarter of the nineteenth century. The children here, sleeping on stones at night, are predictive of the dead child lying on the stones on the main street in Tralee mentioned in the opening lines of this study.

> 'I went to a sort of hamlet near to the town of Midleton. It contained about 40 or 50 hovels. I went into several of them, and took down the names of the occupiers. They all consisted of mud-walls, with a covering of rafters and straw. None of them so good as the place where you keep your little horse. I took a particular account of the first that I went into. It was 21 feet long and 9 feet wide. The floor was bare ground. No fire-place, no chimney, the fire (made of Potato-haulm) made on one side against the wall, and the smoke going out of a hole in the roof. No table, no chair: I sat to write upon a block of wood. Some stones for seats. No goods but *a pot*, and a shallow tub, for the pig and the family both to eat out of. There was one window, 9 inches by 5, and the glass broken half out. There was a mud-wall about 4 feet high to separate off the end of the shed for the family to sleep, lest the hog should kill and eat the little children when the father and mother were both out, and when the hog was shut in. No bed: no mattress; some large flat stones laid on other stones, to keep the bodies from the damp ground; some dirty straw and a bundle of rags were all the bedding. The man's name was Owen Gumbleton. *Five small children*; the mother, about thirty, naturally handsome, but worn into half-ugliness by hunger and filth; she had no shoes or stockings, no shift, a mere rag over her body and down to her knees. The man BUILT THIS PLACE HIMSELF, and yet he has to pay a *pound a year* for it with perhaps a rod of ground! Other 25s. a year. *All built their own hovels*, and yet have to pay this rent. All the hogs were in the hovels today, it being coldish and squally; and then, you know hogs like cover. Gumbleton's hog was lying in the room; and in another hovel there was a fine large hog that had taken his bed close by the fire. There is a nasty dunghill (no privy) to each hovel. The dung that the hog make *in the hovel* is carefully put into a heap by itself, as being the most precious. This dung and the pig are the main things to raise rent and get fuel with. The poor creatures sometimes keep the dung in the hovel, when their hard-hearted tyrants will not suffer them to let it be at the door. So there they are, in a far worse state, Marshall, than any hog that you ever had in your life' (O'Flanagan 1993, 439).

8.3 Conclusions

The eighteenth, and particularly the nineteenth, centuries in Ireland are very well documented. There is the temptation to ask what more is there to learn about the period above that which is already documented? Human skeletal remains provide a unique perspective in terms of historical narratives because, unlike the recorders of history, the bones of the people of history do not lie. Crucially this study focuses on a period that is virtually untouched in Irish osteoarchaeology. It adds substantially to the existing state of knowledge of the eighteenth and nineteenth century Ireland, in terms of expanding the current information on the physical well-being (or not) of the various socio-economic classes.

It is apparent that the health of the population in general declined from the medieval through to the post-medieval period. This is despite the vast improvements in both the availability and quality of foodstuffs in the latter period. While there are a great number of reasons why this decline occurred, it is intimately linked to the very fact of why there was an increase in foodstuffs to begin with, that is the development of modern economies. Ireland's close links with Britain ensured that the Ireland became increasingly exposed to external shocks.

The two basic hypotheses in this study were that health status may indeed be identified in human skeletal remains, and that health status is intimately linked with socio-economic status. Both were conclusively evident in the analysis of the population groups in this study. Socio-economic status had a significant influence on the physical body of the individual. The lower the socio-economic status, the more compromised the health of an individual was. 'Social influences become literally embodied into physio-anatomic characteristics' (Krieger and Davey Smith 2004, 92). In addition however, sex may be seen to be highly influential in the response of individuals to physiological stresses.

A crucial factor in the interpretation of the stress markers is that, even in contemporary population, the nature of the stresses may differ as may the reaction of the various groups to them. There may be very valid questions regarding the reliability of traditional interpretations. However, when the analysis is undertaken using material with a sound contextual background then the results may greatly enhance existing knowledge. The analysis of the middleclass group reveals relatively little with regards to their health status, in that they were broadly comparable with their contemporaries elsewhere, albeit with some variations. The analysis of the urban group reflects the mixed nature of the assemblage, and certainly highlights the hazards of urban life in the period in question. The workhouse group succinctly revealed the absolute severe stress that the lowliest of the poor endured from birth. That group, the one linked specifically with the turbulent years of the Great Famine, do not represent the survivors of the famine. They cannot be said to even represent the poor in general. They represent instead what has proved to be a unique subset of the poor, the pauper, an individual whose entire physical makeup was impacted on by their social status. An important related factor is that contextual data may also help to locate populations that may in life have been 'invisible', and may represent a distinct subset of a socio-economic group. This also warns against using data from a skeletal sample as being entirely representative of a major group, until there is sound contextual grounding of that sample.

Ireland's socio-economic status in the nineteenth century was moulded by the policies of Britain in Ireland in that and the preceding centuries. The manner in which the huge population of poor were dealt with by Britain differed to how the poor were treated in Britain. As such, Britain's involvement in Ireland intimately influenced the physical form of the people, with the poor in both rural and urban contexts significantly affected in a negative manner. Despite the fact that Ireland was then considered part of Britain, this was not reflected in the treatment of the poor in Ireland.

It is apparent that in those tumultuous decades of the mid-nineteenth century, that description of Ireland as a 'vast lazar house' was true only for a portion of the population. Socio-economic developments ensured however that the growing numbers of poor had less access to the resources, being increasingly confined to limited sustenance, the potato. When that was gone, the fragile world of the poor turned chaotic, resulting in years of famine, disease, and death. While contagious disease and problems of dietary deficiencies could affect both rich and poor, the former, by their very living conditions, were ultimately most susceptible to deprivation. 'The body is the nexus between biology and culture' (Sofaer 2006, 30). The physical, social or individual body cannot be separated. As such, the skeletal remains of all these people bear witness to their socio-economic status in life. This study emphasises that this period, which is virtually untapped in terms of osteoarchaeological studies in Ireland, has the potential to greatly enhance the existing historical data to provide more nuanced and enriched narratives of the past.

APPENDICES

9.1 Data on Stature[††] and Long Bone Length[‡‡]

Class	Site	Skel	Sex	Age	Stature (cm)	S.D	Bone/s Used	L. Hum.	R. Hum.	L. Rad.	R. Rad	L. Ulna	R. Ulna	L. Fem.	R. Fem.	L. Tib.	R. Tib.	L. Fib.	R. Fib.
Workhouse	Manorh.	43	F	MA	150.4	3.72	l. femur	291	297	-	-	-	235	390	386	-	-	-	-
Workhouse	Manorh.	54	F	AA	162.7	3.66	l. tibia	-	-	-	-	-	-	-	-	349	347	-	-
Workhouse	Manorh.	60	F	OA	166.5	4.45	r. hum.	-	323	-	-	-	-	-	-	-	-	-	-
Workhouse	Manorh.	66	F	MA	172.8	3.67	l. hum. & tib.	339	-	-	-	-	-	-	-	381	-	-	-
Workhouse	Manorh.	75	F	AA	159.2	4.24	r. rad.	-	-	-	220	-	-	-	-	-	-	-	-
Workhouse	Manorh.	109	F	AA	148.7	4.3	r. ulna	-	284	-	-	-	213	-	-	-	-	-	-
Workhouse	Manorh.	133	F	MA	156.9	3.66	l. tibia	-	-	-	-	-	-	-	410	329	-	-	-
Workhouse	Manorh.	194	F	MA	148	4.45	r. hum.	-	268	-	-	-	-	-	-	-	-	-	-
Workhouse	Manorh.	235	F	MA	150.7	3.72	l. femur	-	274	-	-	-	-	391	388	-	-	-	-
Workhouse	Manorh.	255	F	AA	173	4.24	l. rad.	333	-	249	-	271	-	-	-	-	-	-	-
Workhouse	Cashel	5	F	MA	158.3	3.51	l. hum. fem. tib.	291	294	214	217	-	-	420	418	341	339	327	-
Workhouse	Cashel	9	F	MA	156.8	3.51	l. hum. fem. tib.	292	295	213	214	-	223	422	423	326	324	323	323
Workhouse	Cashel	31	F	MA	157.8	3.51	l. hum. fem. tib.	297	298	-	221	239	241	408	406	346	346	-	-
Workhouse	Cashel	40	F	MA	148.4	3.51	r. hum. fem. tib.	-	275	-	203	219	223	375	370	314	315	-	-

[††] All stature estimates are in centimeters
[‡‡] All long bone lengths are in millimeters

Workhouse	Cashel	48	F	MA	152.1	4.24	r. rad.	-	292	-	205	218	-	-	-	-	-	-	-
Workhouse	Cashel	50	F	MA	155	3.51	l. hum. fem. tib.	297	298	210	-	226	-	404	398	325	324	-	-
Workhouse	Manorh.	7	M	AA	168.4	4.32	l. ulna	-	-	234	-	255	-	-	-	-	-	-	-
Workhouse	Manorh.	41	M	AA	169	4.32	r. rad.	-	-	-	238	-	-	-	-	-	-	-	-
Workhouse	Manorh.	62	M	MA	158.4	4.32	r. ulna	-	-	-	-	-	228	-	-	-	-	-	-
Workhouse	Manorh.	102	M	OA	161.9	4.05	l. hum.	297	303	217	-	239	236	-	-	-	-	-	-
Workhouse	Manorh.	127	M	MA	162.1	2.99	l. fem. & tib.	-	-	-	-	-	-	426	-	334	-	-	-
Workhouse	Manorh.	210	M	MA	170.8	2.99	l. fem. & tib.	332	337	-	242	-	-	468	473	359	361	-	-
Workhouse	Manorh.	231	M	OA	172.1	3.27	l. femur	-	-	-	261	-	-	465	467	-	-	-	-
Workhouse	Manorh.	251	M	MA	174.6	4.05	r. hum.	-	338	-	-	-	-	-	-	-	-	-	-
Workhouse	Cashel	3	M	MA	168.7	2.99	l. fem. & tib.	-	-	-	228	246	-	450	-	361	357	-	-
Workhouse	Cashel	4	M	MA	165.5	2.99	l. fem. & tib.	313	-	225	224	243	239	436	-	350	-	346	-
Workhouse	Cashel	10	M	MA	176.3	2.99	r. fem. & tib.	340	340	256	-	-	283	-	485	388	384	-	-
Workhouse	Cashel	11	M	MA	170.9	3.37	l. tibia	315	327	245	247	-	267	-	-	366	-	-	-
Workhouse	Cashel	13	M	MA	157.4	2.99	l. fem. & tib.	288	295	222	223	234	233	402	399	322	302	-	-
Workhouse	Cashel	14	M	MA	167.9	2.99	l. fem. & tib.	312	318	-	235	259	-	440	442	365	-	-	-
Workhouse	Cashel	15	M	MA	161.7	2.99	l. fem. & tib.	316	315	228	-	-	250	409	-	348	-	-	-
Workhouse	Cashel	27	M	MA	169.5	2.99	l. fem. & tib.	339	342	243	247	265	272	452	452	365	369	363	362
Workhouse	Cashel	30	M	OA	158.6	2.99	l. fem. & tib.	308	312	-	236	256	-	413	-	320	-	-	-
Workhouse	Cashel	32	M	MA	171.2	2.99	l. fem. & tib.	327	332	-	255	269	275	456	457	374	373	372	-
Workhouse	Cashel	47	M	MA	167.3	2.99	l. fem. & tib.	322	324	-	235	257	-	453	452	347	347	332	332
Middleclass	John the B.	8	F	MA	171.4	3.55	l. fem. & tib.	-	-	-	-	-	-	471	460	379	-	-	-
Middleclass	John the B.	12	F	OA	170.9	3.55	l. fem. & tib.	-	-	-	-	-	-	471	463	376	380	-	-
Middleclass	John the B.	14	F	MA	154.5	3.55	l. fem. & tib.	-	-	-	-	-	-	415	418	314	312	-	-
Middleclass	John the B.	15	F	YA	167.7	3.66	l. tibia	-	-	-	-	-	-	-	-	366	-	-	-
Middleclass	John the B.	17	F	AA	162.8	4.3	r. ulna	-	-	-	-	-	246	-	-	-	-	-	-
Middleclass	John the B.	18	F	MA	159.1	3.55	l. fem. & tib.	-	-	-	-	-	-	433	434	329	332	-	-
Middleclass	John the B.	23	F	MA	163.5	4.24	r. rad.	-	319	-	229	-	251	-	-	-	-	-	-
Middleclass	John the B.	26	F	YA	158.1	3.55	l. fem. & tib.	-	-	-	-	-	-	425	427	330	336	-	-
Middleclass	John the B.	30	F	AA	151.9	3.66	l. tibia	-	287	-	200	220	-	-	395	315	-	-	-
Middleclass	John the B.	31	F	MA	160.8	3.55	r. fem. & tib.	-	-	-	-	-	-	-	442	326	332	-	-
Middleclass	John's Lane	20	F	MA	161.8	3.55	r. fem. & tib.	317	-	226	-	243	-	428	426	-	355	-	-

Middleclass	Church St.	285	F	YA	156.4	4.24	l. rad.	300	294	214	215	233	235	-	-	-	-	-	-
Middleclass	St Facthna's	10	F	MA	157.6	3.72	l. femur	-	-	219	-	-	-	-	-	-	-	-	-
Middleclass	St Mary's	28	F	MA	155.9	3.55	l. fem. & tib.	-	-	203	204	224	226	415	412	324	326	324	-
Middleclass	John the B.	1	M	MA	178.6	4.05	r. hum.		351		257		278						
Middleclass	John the B.	2	M	AA	167.2	4.05	l. hum.	314											
Middleclass	John the B.	3	M	MA	168.1	2.99	l. fem. & tib.							444	435	362	362		
Middleclass	John the B.	4	M	OA	177.3	4.32	r. ulna						279						
Middleclass	John the B.	5	M	MA	171.3	2.99	l. fem. & tib.							465		366	370		
Middleclass	John the B.	7	M	MA	171.2	2.99	l. fem. & tib.							460		370	370		
Middleclass	John the B.	9	M	MA	171.1	3.27	l. femur							461					
Middleclass	John the B.	13	M	YA	163.9	2.99	l. fem. & tib.							424	428	350	345		
Middleclass	John the B.	16	M	MA	169.9	3.27	l. femur							456	453				
Middleclass	John the B.	20	M	MA	176.1	2.99	r. fem. & tib.								479	391	389		
Middleclass	John the B.	22	M	MA	167.6	3.37	l. tibia		325		259		241			353			
Middleclass	John the B.	24	M	AA	179.5	4.05	l. hum.	354		257		277							
Middleclass	John the B.	29	M	OA	177.8	2.99	l. fem. & tib.							477	491	393	391		
Middleclass	John's Lane	10	M	AA	167.6	3.37	r. tibia										353		
Middleclass	John's Lane	19	M	OA	176.1	4.05	r. hum.		343										
Middleclass	John's Lane	22	M	AA	177.7	3.37	r. tibia										393		
Middleclass	John's Lane	24	M	AA	170.1	3.37	l. tibia									363			
Middleclass	Church St.	301	M	AA	173.3	4.05	l. hum.	334											
Middleclass	St Facthna's	12	M	AA	177.9	3.37	r. tibia										394		
Middleclass	St Facthna's	13	M	AA	176.1	3.27	l. femur							482	484				
Middleclass	St Facthna's	9	M	MA	172.5	4.32	l. ulna					266							
Middleclass	St Facthna's	11	M	MA	170.9	4.32	r. rad.				243								
Middleclass	St Facthna's	2	M	MA	167.3	4.32	r. ulna			227	232		252						
Middleclass	St Mary's	23	M	OA	177.2	3.37	l. tibia	356	365	256		285	284			391	401	394	399
Middleclass	St Mary's	20	M	OA	165.1	4.32	l. ulna			235		246							

Middleclass	St Mary's	13	M	MA	166.9	4.05	l. hum.	313	315		237	259							
Middleclass	St Mary's	10	M	MA	171.1	2.99	l. fem. & tib.					271		462	458	367	365		
Middleclass	St Mary's	4	M	MA	168	3.27	l. femur							448					
Middleclass	St Mary's	2	M	MA	171.3	2.99	l. fem. & tib.		333		249			462	463	369	372		
Urban	St Anne's	1	F	MA	159.5	3.57	l. fib.		303		217				435	351		341	343
Urban	St Anne's	4	F	MA	153.7	3.55	r. fem. & tib.								402		321		308
Urban	St Anne's	8	F	AA	160.6	3.72	l. femur							431					
Urban	St Anne's	23	F	AA	165.6	3.66	l. tibia									359			
Urban	St Anne's	25	F	MA	155.6	3.55	l. fem. & tib.			211	216	233		403		335	337	327	328
Urban	St Anne's	27	F	OA	147.8	4.24	r. rad.				196								
Urban	St Anne's	34	F	OA	157.8	4.45	r. hum.		297										
Urban	St Anne's	37	F	MA	149.9	3.57	r. fib.		284				208			313	311		308
Urban	St Anne's	38	F	AA	153	4.24	l. rad.			207									
Urban	St Anne's	40	F	MA	156.6	3.72	r. femur								415				
Urban	St Anne's	48	F	MA	156.8	3.51	l. hum. fem. tib.	291		208				422	418	326	329		
Urban	St Anne's	50	F	OA	154.8	3.57	l. fib.		285		200				395	329		325	
Urban	St Anne's	53	F	MA	162.5	4.24	r. rad.				227	240							
Urban	St Anne's	56	F	MA	161.6	4.24	r. rad.		305	225	220	244	242						
Urban	St Anne's	57	F	MA	157.8	3.72	l. femur			204				420					
Urban	St Anne's	61	F	MA	163	3.55	l. fem. & tib.			228	230	248		432		358			
Urban	St Anne's	63	F	AA	162.2	3.66	r. tibia	292									347		
Urban	St Anne's	66	F	OA	160.4	3.57	l. fib.	297					225					344	
Urban	St Anne's	70	F	MA	163	3.55	r. fem. & tib.	327		230	229		246		440		350		343
Urban	St Anne's	72	F	OA	152.9	3.55	r. fem. & tib.								396	322	321		
Urban	St Anne's	75	F	OA	158.8	4.45	l. hum.	300	305										
Urban	St Anne's	79	F	YA	158.5	4.3	l. ulna	304				236							
Urban	St Anne's	80	F	OA	148.4	4.45	r. hum.		269										
Urban	St Anne's	81	F	MA	155.2	3.66	l. tibia			203	209					323	326		
Urban	St Anne's	87	F	AA	156.4	4.24	r. rad.				214	230	231						
Urban	St Anne's	97	F	MA	157.3	3.72	l. femur							418					
Urban	St Anne's	99	F	AA	157.4	4.45	l. hum.	296											
Urban	St Anne's	100	F	AA	162.8	3.55	l. femur							440					

Urban	St Anne's	101	F	AA	158.1	3.55	l. femur							421					
Urban	St Anne's	102	F	AA	156.1	3.55	l. femur							413					
Urban	St Anne's	110	F	AA	161	3.66	l. tibia									343	345		
Urban	St Anne's	112	F	AA	163.3	3.66	l. tibia									351			
Urban	St Anne's	116	F	OA	144.3	4.45	r. hum.		257										
Urban	St Anne's	118	F	MA	157.3	3.72	l. femur							418					
Urban	St Anne's	128	F	AA	152.4	3.55	r. fem. & tib.								400		314		
Urban	St Anne's	133	F	AA	164	3.72	l. femur		306		231			445	450				
Urban	St Anne's	143	F	AA	156.9	3.72	l. femur							416					
Urban	St Anne's	158	F	AA	162.3	3.72	l. femur							438					
Urban	St Anne's	159	F	MA	159	3.66	l. tibia								441	336			
Urban	St Anne's	160	F	AA	161.6	3.55	r. fem. & tib.								442	337	337		
Urban	St Anne's	171	F	OA	152.9	3.72	r. femur								400				
Urban	St Anne's	172	F	MA	154.8	3.57	r. fib.	296	298	224	222	245	241			330	327		325
Urban	St Anne's	179	F	MA	151.9	3.57	l. fib.			195		209				322	320	315	314
Urban	St Anne's	181	F	OA	154.1	4.45	r. hum.		286										
Urban	St Anne's	188	F	AA	154.6	3.72	r. femur								407				
Urban	St Anne's	193	F	AA	159.3	3.55	l. fem. & tib.		311					430	432	333			
Urban	St Anne's	197	F	AA	152.7	3.72	r. femur								399				
Urban	St Anne's	228	F	AA	155.5	3.55	l. fem. & tib.							409	408	327	326		
Urban	St Anne's	236	F	MA	157.1	3.72	l. femur							417	412				
Urban	St Anne's	244	F	AA	160.6	3.55	r. fem. & tib.								431		342		
Urban	St Anne's	246	F	OA	156.6	3.51	r. hum. fem. tib.		301		204			409	413	332	328		
Urban	St Anne's	252	F	AA	168	3.72	r. femur								461				
Urban	St Anne's	253	F	AA	164.8	3.66	r. tibia										356		
Urban	St Anne's	2	M	MA	163	2.99	l. fem. & tib.	306	315	225		243		436	443	331	330		
Urban	St Anne's	10	M	MA	176.1	3.27	l. femur	340	344	243			262	482					
Urban	St Anne's	12	M	AA	178.5	2.99	r. fem. & tib.		339		251			480	483		403		394
Urban	St Anne's	13	M	YA	172.4	2.99	l. fem. & tib.	323	327	251		272	272	461		378	377		
Urban	St Anne's	14	M	YA	174	3.27	l. femur	326	329	248				473	471				
Urban	St Anne's	15	M	MA	164.3	2.99	l. fem. & tib.		317	232	236		257	436	426	341	337		
Urban	St Anne's	16	M	MA	174.8	2.99	l. fem. & tib.	338	341	245	251	262		469	465	389	395	380	388

Urban	St Anne's	19	M	MA	174.8	2.99	l. fem. & tib.			259		277	281	467	468	391	394		
Urban	St Anne's	22	M	YA	171.8	4.05	l. hum.	329		242		262							
Urban	St Anne's	24	M	OA	171.4	3.27	l. femur	319		239		252		462					
Urban	St Anne's	28	M	MA	164.5	3.29	r. fib.		306	241	238		260						346
Urban	St Anne's	32	M	MA	170.1	3.29	l. fib.						255			364	364	367	
Urban	St Anne's	33	M	MA	174.7	2.99	l. fem. & tib.		332	248	249		273	465		392	392	384	
Urban	St Anne's	35	M	MA	165.6	4.05	l. hum.	309		235	239		254						
Urban	St Anne's	43	M	OA	162	2.99	l. fem. & tib.							414	410	345			
Urban	St Anne's	46	M	MA	176.1	3.37	l. tibia									387			
Urban	St Anne's	55	M	MA	162.3	3.27	r. femur			232					424				
Urban	St Anne's	60	M	MA	175.7	2.99	l. fem. & tib.				251		271	480		385	377		
Urban	St Anne's	71	M	MA	177.2	2.99	r. fem. & tib.		361		251	273	273	487	483		393		
Urban	St Anne's	88	M	OA	154.2	3.27	l. femur			209		228		390					
Urban	St Anne's	90	M	AA	174.1	3.37	r. tibia										397		
Urban	St Anne's	91	M	AA	177.2	3.37	r. tibia										391		
Urban	St Anne's	92	M	YA	164.7	4.05	l. hum.	306	309										
Urban	St Anne's	95	M	AA	171.8	4.05	l. hum.	329											
Urban	St Anne's	98	M	AA	172.1	2.99	r. fem. & tib.								453		384		
Urban	St Anne's	115	M	MA	167.8	4.32	r. rad.				235								
Urban	St Anne's	123	M	MA	169.5	3.27	l. femur	328	333		239			454	456				
Urban	St Anne's	127	M	OA	162.9	4.32	r. rad.				222								
Urban	St Anne's	130	M	AA	171.2	4.05	l. hum.	327											
Urban	St Anne's	131	M	MA	162.7	2.99	l. fem. & tib.							419		346			
Urban	St Anne's	132	M	YA	172.6	3.27	l. femur						258	467					
Urban	St Anne's	137	M	YA	175	4.32	l. rad.			254									
Urban	St Anne's	139	M	YA	172.8	3.27	l. femur							468	467				
Urban	St Anne's	146	M	MA	183.2	4.05	r. hum.		366		273								
Urban	St Anne's	149	M	AA	167.6	3.27	l. femur							446					
Urban	St Anne's	150	M	OA	168.5	3.27	r. femur								450				
Urban	St Anne's	151	M	AA	165.4	3.27	r. femur								437				
Urban	St Anne's	152	M	AA	177.6	4.05	l. hum.	348											
Urban	St Anne's	154	M	AA	162.6	2.99	l. fem. & tib.							432	427	332	330		331

Urban	St Anne's	155	M	MA	173	3.27	l. femur	328		229		256		469	465				
Urban	St Anne's	156	M	AA	167.6	3.37	r. tibia										353		
Urban	St Anne's	162	M	MA	171.8	4.05	l. hum.	329	330		243		261						
Urban	St Anne's	164	M	AA	171.6	4.32	l. rad.			245									
Urban	St Anne's	173	M	OA	169.6	3.29	r. fib.										365		365
Urban	St Anne's	177	M	AA	172.7	4.05	r. hum.		332										
Urban	St Anne's	182	M	AA	169.3	3.37	l. tibia									360			
Urban	St Anne's	183	M	MA	177	4.05	r. hum.		346		260								
Urban	St Anne's	192	M	OA	161.2	2.99	l. fem. & tib.			218	223	213	222	431	427	322	320		
Urban	St Anne's	194	M	MA	173.7	3.27	l. femur			241				472					
Urban	St Anne's	195	M	AA	176.1	3.27	r. femur								482				
Urban	St Anne's	196	M	MA	170.5	4.32	r. rad.				242								
Urban	St Anne's	207	M	YA	173.6	4.05	r. hum.		335		237								
Urban	St Anne's	210	M	MA	165.3	3.29	l. fib.		317		239	254					357	349	
Urban	St Anne's	215	M	AA	167.6	3.27	l. femur		326		242			446	454				
Urban	St Anne's	220	M	AA	176.8	3.27	l. femur							485					
Urban	St Anne's	221	M	MA	167.5	4.05	l. hum.	315				258							
Urban	St Anne's	222	M	AA	168.3	2.99	r. fem. & tib.								451		357		
Urban	St Anne's	223	M	MA	167.8	3.27	l. femur							447					
Urban	St Anne's	232	M	AA	167.8	4.05	l. hum.	316											
Urban	St Anne's	238	M	OA	158	3.27	l. femur							406					
Urban	St Anne's	240	M	MA	171.8	3.27	r. femur								464				
Urban	St Anne's	241	M	MA	173.7	2.99	l. fem. & tib.		326	239				476		373			
Urban	St Anne's	242	M	AA	173.5	3.27	l. femur							471	468				
Urban	St Anne's	251	M	MA	180.4	2.99	l. fem. & tib.	346	350					504	502	397			
Urban	St Anne's	258	M	MA	158.2	4.05	l. hum.	285	287	207	207	228	226						
Urban	St Anne's	261	M	YA	177.3	4.05	l. hum.	347				273							
Urban	St Anne's	264	M	AA	173.4	3.37	l. tibia									376			
Urban	St Anne's	267	M	MA	180.3	2.99	l. fem. & tib.			258		277		501	498	399	400		

9.2 Data on Caries and Ante-mortem Tooth Loss

Class	Site	Skel	Sex	Age	No. of teeth	No. of sockets	Teeth w/caries	Teeth lost AM
Workhouse	Manorh.	43	F	YA	0	32	0	22
Workhouse	Manorh.	45	F	AA	12	16	6	4
Workhouse	Manorh.	54	F	AA	14	26	9	5
Workhouse	Manorh.	60	F	OA	4	32	1	25
Workhouse	Manorh.	66	F	MA	13	21	6	3
Workhouse	Manorh.	75	F	AA	0	20	0	18
Workhouse	Manorh.	80	F	AA	0	16	0	16
Workhouse	Manorh.	84	F	AA	0	3	0	3
Workhouse	Manorh.	93	F	MA	11	11	10	0
Workhouse	Manorh.	98	F	AA	0	18	0	18
Workhouse	Manorh.	109	F	AA	2	28	1	22
Workhouse	Manorh.	113	F	OA	0	16	0	16
Workhouse	Manorh.	123	F	OA	0	19	0	19
Workhouse	Manorh.	133	F	MA	24	30	8	1
Workhouse	Manorh.	143	F	AA	6	18	3	4
Workhouse	Manorh.	145	F	MA	21	10	0	0
Workhouse	Manorh.	153	F	AA	18	1	4	0
Workhouse	Manorh.	157	F	AA	19	11	0	1
Workhouse	Manorh.	161	F	AA	0	27	0	20
Workhouse	Manorh.	194	F	MA	13	28	12	5
Workhouse	Manorh.	202	F	MA	19	29	19	4
Workhouse	Manorh.	206	F	AA	8	13	8	4
Workhouse	Manorh.	235	F	MA	2	22	1	9
Workhouse	Manorh.	239	F	AA	1	23	0	21
Workhouse	Manorh.	243	F	AA	0	16	0	16
Workhouse	Manorh.	255	F	AA	15	30	4	12
Workhouse	Manorh.	267	F	AA	8	26	2	18
Workhouse	Cashel	5	F	MA	13	32	8	18
Workhouse	Cashel	9	F	MA	16	32	11	15

Workhouse	Cashel	31	F	MA	20	32	4	10
Workhouse	Cashel	40	F	MA	2	22	2	21
Workhouse	Cashel	43	F	OA	0	20	0	20
Workhouse	Cashel	48	F	MA	10	32	5	22
Workhouse	Cashel	50	F	MA	26	31	13	4
Workhouse	Manorh.	7	M	AA	22	6	2	1
Workhouse	Manorh.	20	M	AA	0	20	0	20
Workhouse	Manorh.	31	M	AA	18	23	2	4
Workhouse	Manorh.	41	M	AA	0	18	0	12
Workhouse	Manorh.	57	M	AA	10	15	10	1
Workhouse	Manorh.	62	M	AA	4	28	2	13
Workhouse	Manorh.	71	M	AA	31	31	1	0
Workhouse	Manorh.	102	M	OA	2	16	2	3
Workhouse	Manorh.	151	M	AA	29	23	7	0
Workhouse	Manorh.	198	M	AA	0	26	0	26
Workhouse	Manorh.	210	M	MA	27	32	1	0
Workhouse	Manorh.	215	M	AA	17	18	2	1
Workhouse	Manorh.	222	M	AA	4	25	4	13
Workhouse	Manorh.	227	M	AA	6	25	1	21
Workhouse	Manorh.	231	M	OA	4	29	3	19
Workhouse	Manorh.	251	M	MA	9	27	3	10
Workhouse	Manorh.	259	M	MA	4	27	3	16
Workhouse	Manorh.	263	M	AA	0	16	0	11
Workhouse	Cashel	3	M	MA	16	32	6	17
Workhouse	Cashel	4	M	MA	22	28	10	7
Workhouse	Cashel	10	M	MA	4	26	3	20
Workhouse	Cashel	11a	M	MA	30	28	0	0
Workhouse	Cashel	13	M	MA	24	32	4	4
Workhouse	Cashel	14	M	MA	0	26	0	26
Workhouse	Cashel	15	M	MA	24	27	11	6
Workhouse	Cashel	27	M	MA	30	28	5	0
Workhouse	Cashel	29	M	OA	3	24	3	19

Workhouse	Cashel	30	M	OA	18	31	17	10
Workhouse	Cashel	32	M	MA	19	32	11	7
Workhouse	Cashel	47	M	MA	13	32	7	16
Middleclass	John the B.	8	F	MA	30	32	1	0
Middleclass	John the B.	14	F	MA	12	32	4	20
Middleclass	John the B.	15	F	YA	18	24	1	2
Middleclass	John the B.	17	F	AA	1	0	1	0
Middleclass	John the B.	23	F	MA	13	29	2	9
Middleclass	John the B.	26	F	YA	24	29	2	0
Middleclass	John the B.	32	F	MA	1	30	0	20
Middleclass	John's Lane	16	F	MA	18	9	0	0
Middleclass	Church St	289	F	AA	16	25	3	5
Middleclass	Church St	????	F	YA	19	16	0	0
Middleclass	St Mary's	24???	F	YA	29	32	5	0
Middleclass	John the B.	2	M	AA	10	6	6	0
Middleclass	John the B.	3	M	MA	24	30	9	5
Middleclass	John the B.	5	M	MA	32	32	0	0
Middleclass	John the B.	7	M	MA	15	16	2	0
Middleclass	John the B.	13	M	YA	22	27	5	0
Middleclass	John the B.	20	M	MA	30	32	6	2
Middleclass	John the B.	22	M	MA	29	29	0	0
Middleclass	John the B.	29	M	OA	12	0	3	0
Middleclass	John the B.	16	M	MA	30	31	5	0
Middleclass	John's Lane	19	M	OA	20	29	0	10
Middleclass	John's Lane	11	M	MA	23	22	3	0
Middleclass	John's Lane	14	M	AA	18	22	4	2
Middleclass	St Mary's	23	M	OA	15	26	4	8
Middleclass	St Mary's	20	M	OA	6	9	1	0
Middleclass	St Mary's	13	M	MA	23	32	1	0
Middleclass	St Mary's	10	M	MA	25	32	1	0
Middleclass	St Mary's	2	M	MA	27	32	3	3
Middleclass	John the B.	27	?	AA	15	15	0	0

Middleclass	John the B.	28	?	AA	16	6	0	0
Middleclass	John the B.	32	?	AA	11	16	7	3
Urban	St Anne's	14	F	YA	17	21	13	0
Urban	St Anne's	1	F	MA	25	32	3	5
Urban	St Anne's	4	F	MA	27	15	2	0
Urban	St Anne's	37	F	MA	29	32	4	3
Urban	St Anne's	40	F	MA	14	16	4	3
Urban	St Anne's	48	F	MA	21	16	5	0
Urban	St Anne's	53	F	MA	21	30	0	9
Urban	St Anne's	57	F	MA	24	29	0	2
Urban	St Anne's	31	F	MA	20	30	1	7
Urban	St Anne's	70	F	MA	31	32	0	0
Urban	St Anne's	81	F	MA	27	23	0	0
Urban	St Anne's	118	F	MA	3	0	2	0
Urban	St Anne's	140	F	MA	26	32	1	3
Urban	St Anne's	172	F	MA	21	30	18	6
Urban	St Anne's	179	F	MA	3	13	1	7
Urban	St Anne's	27	F	OA	13	30	2	17
Urban	St Anne's	34	F	OA	18	26	3	6
Urban	St Anne's	50	F	OA	0	23	0	21
Urban	St Anne's	66	F	OA	10	29	3	19
Urban	St Anne's	72	F	OA	2	14	2	5
Urban	St Anne's	75	F	OA	12	32	5	18
Urban	St Anne's	116	F	OA	19	31	5	7
Urban	St Anne's	126	F	OA	18	32	2	9
Urban	St Anne's	147	F	OA	30	32	0	0
Urban	St Anne's	171	F	OA	0	15	0	15
Urban	St Anne's	181	F	OA	5	15	3	2
Urban	St Anne's	246	F	OA	19	24	5	9
Urban	St Anne's	7	F	AA	8	20	6	15
Urban	St Anne's	8	F	AA	6	21	3	17
Urban	St Anne's	38	F	AA	3	17	2	15

Urban	St Anne's	63	F	AA	26	29	1	0
Urban	St Anne's	82	F	AA	15	16	7	2
Urban	St Anne's	87	F	AA	15	22	9	4
Urban	St Anne's	96	F	AA	12	24	2	1
Urban	St Anne's	99	F	AA	26	30	1	0
Urban	St Anne's	100	F	AA	9	7	3	2
Urban	St Anne's	125	F	AA	17	17	0	0
Urban	St Anne's	133	F	AA	23	27	6	1
Urban	St Anne's	163	F	AA	20	19	0	0
Urban	St Anne's	190	F	AA	2	0	0	0
Urban	St Anne's	197	F	AA	17	22	9	6
Urban	St Anne's	229	F	AA	1	15	0	11
Urban	St Anne's	248	F	AA	25	28	0	0
Urban	St Anne's	252	F	AA	27	28	9	1
Urban	St Anne's	23	F	AA	23	24	2	0
Urban	St Anne's	13	M	YA	26	30	0	1
Urban	St Anne's	14	M	YA	31	30	1	0
Urban	St Anne's	21	M	YA	17	16	1	0
Urban	St Anne's	22	M	YA	32	30	4	0
Urban	St Anne's	59	M	YA	21	14	6	1
Urban	St Anne's	92	M	YA	29	32	0	0
Urban	St Anne's	132	M	YA	31	32	0	0
Urban	St Anne's	137	M	YA	31	32	9	0
Urban	St Anne's	207	M	YA	32	32	0	0
Urban	St Anne's	230	M	YA	26	26	4	1
Urban	St Anne's	235	M	YA	6	0	2	0
Urban	St Anne's	2	M	MA	23	24	0	2
Urban	St Anne's	10	M	MA	30	28	2	2
Urban	St Anne's	15	M	MA	1	0	1	0
Urban	St Anne's	16	M	MA	32	32	1	0
Urban	St Anne's	28	M	MA	6	15	3	6
Urban	St Anne's	32	M	MA	0	24	0	24

Urban	St Anne's	51	M	MA	6	32	1	23
Urban	St Anne's	60	M	MA	26	32	6	6
Urban	St Anne's	71	M	MA	29	32	9	3
Urban	St Anne's	115	M	MA	16	32	10	10
Urban	St Anne's	123	M	MA	14	32	7	13
Urban	St Anne's	146	M	MA	11	31	3	4
Urban	St Anne's	155	M	MA	29	32	7	1
Urban	St Anne's	162	M	MA	32	31	0	0
Urban	St Anne's	183	M	MA	31	21	1	0
Urban	St Anne's	184	M	MA	18	0	5	0
Urban	St Anne's	196	M	MA	29	32	2	0
Urban	St Anne's	221	M	MA	31	29	0	0
Urban	St Anne's	241	M	MA	25	32	0	1
Urban	St Anne's	251	M	MA	21	32	6	6
Urban	St Anne's	258	M	MA	21	24	2	1
Urban	St Anne's	280	M	MA	28	32	1	0
Urban	St Anne's	281	M	MA	31	20	0	0
Urban	St Anne's	35	M	MA	11	22	0	1
Urban	St Anne's	46	M	MA	28	32	4	1
Urban	St Anne's	24	M	OA	6	0	0	0
Urban	St Anne's	43	M	OA	0	7	0	7
Urban	St Anne's	54	M	OA	12	14	8	0
Urban	St Anne's	150	M	OA	0	14	0	14
Urban	St Anne's	173	M	OA	7	6	2	2
Urban	St Anne's	192	M	OA	19	30	4	8
Urban	St Anne's	12	M	AA	2	0	0	0
Urban	St Anne's	98	M	AA	2	0	0	0
Urban	St Anne's	117	M	AA	1	0	0	0
Urban	St Anne's	120	M	AA	29	32	7	0
Urban	St Anne's	134	M	AA	17	30	4	1
Urban	St Anne's	149	M	AA	24	32	14	1
Urban	St Anne's	152	M	AA	26	27	7	1

Urban	St Anne's	153	M	AA	18	25	2	1
Urban	St Anne's	154	M	AA	24	32	10	0
Urban	St Anne's	156	M	AA	12	8	8	1
Urban	St Anne's	167	M	AA	24	31	15	3
Urban	St Anne's	177	M	AA	20	21	2	1
Urban	St Anne's	200	M	AA	24	32	3	8
Urban	St Anne's	201	M	AA	31	32	6	1
Urban	St Anne's	204	M	AA	25	32	2	3
Urban	St Anne's	205	M	AA	26	32	4	1
Urban	St Anne's	220	M	AA	32	32	0	0
Urban	St Anne's	231	M	AA	10	25	1	3
Urban	St Anne's	232	M	AA	25	27	10	3
Urban	St Anne's	247	M	AA	27	31	0	0
Urban	St Anne's	279	M	AA	4	24	3	19
Urban	St Anne's	17	?	YA	28	17	1	1
Urban	St Anne's	233	?	YA	19	23	4	0
Urban	St Anne's	107	?	MA	29	32	14	3
Urban	St Anne's	64	?	AA	4	11	0	7
Urban	St Anne's	73	?	AA	3	16	0	16
Urban	St Anne's	138	?	AA	15	15	2	1
Urban	St Anne's	168	?	AA	5	12	0	4
Urban	St Anne's	169	?	AA	0	23	0	23
Urban	St Anne's	170	?	AA	13	15	1	1
Urban	St Anne's	199	?	AA	12	2	3	0
Urban	St Anne's	224	?	AA	25	23	0	1

9.3 Data on Non-specific Infection[§§]

Class***	Site	Skel	Sex	Age	Endo	Ecto	Max	Man	Ster	Vert	Sacr	Ribs		Pelv		Clav		Scap		Hum		Ulna		Rad		Hand		Fem		Pat		Tib		Fib		Foot	
												l	r	l	r	l	r	l	r	l	r	l	r	l	r	l	r	l	r	l	r	l	r	l	r	l	r
W	Manorh	43	F	YA	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	66	F	MA	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/
W	Manorh	93	F	MA	/	/	/	/		/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	133	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	145	F	MA	/	/		/	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	194	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	202	F	MA	/	/	X	/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	235	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	60	F	OA	/	/	/	/	/	/		/	/			/	/	/	/	/	/		/		/												
W	Manorh	113	F	OA	/	X		/		/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	123	F	OA	/	/	/	/		/	/			/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/		/	/	/	/	/	
W	Manorh	255	F	AA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	84	F	AA	/	/	/	/		/						/	/	/		/	/	/	/	/	/			/	/			/	/				
W	Manorh	45	F	AA	/	/	/	/		/	/			/	/	/		/	/	/	/		/		/	/	/	/	/		/	/	/	/	/	/	/
W	Manorh	54	F	AA	/	/	/	/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/
W	Manorh	206	F	AA	/	/	/	/		/						/	/	/	/	/	/	/	/	/	/	/		/	/			/	/	/			
W	Manorh	153	F	AA	/	/		/		/		/				/	/	/		/	/	/	/	/	/			/	/			/	/	/		/	/

[§§] Symbols used: / - bone observable, X - bone present and periostitis observed
[***] Abbreviations used: W – Workhouse, M – Middleclass, U - Urban

W	Manorh	143	F	AA	/	/	X	X		/		/	/	/	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/
W	Manorh	109	F	AA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	239	F	AA	/	/	X	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/			/	/	/	/	/	/	/	/		
W	Manorh	267	F	AA	/	/	X	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	98	F	AA	/	/	/	/		/						/		/		/	/	/	/	/	/			/	/			/	/	/	/		
W	Manorh	243	F	AA	/	/		/		/						/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/
W	Manorh	80	F	AA	X	/		/		/		/	/	/	/	/		/		/	/	/	/	X	X	X	X	/	/			/	/				
W	Manorh	75	F	AA	/	/	X	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/								
W	Manorh	161	F	AA	/	/	/	/		/		/	/			/	/	/	/	/	/	/	/	/	/	/		/	/	/						/	/
W	Manorh	157	F	AA	/	/		/		/			/			/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/
W	Cashel	40	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Cashel	50	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Cashel	31	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X
W	Cashel	5	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Cashel	9	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Cashel	48	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Cashel	43	F	OA	/	/	/	/		X	/	X	/	/	/	/	/	/	/	/	/	/	/	/	X	/	X	/	/	/	/	/	/	/	/	/	/
W	Cashel	16	F	AA																													/		/	/	/
W	Manorh	222	M	AA	/	/	X	/		/				/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/	/
W	Manorh	31	M	AA	/	/	/	/		/		/				/		/		/		/		/													
W	Manorh	210	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/	/	/
W	Manorh	41	M	AA	/	/	/	/		/			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/	/
W	Manorh	263	M	AA	/	/		/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/		X	X	X	X		

W	Manorh	20	M	AA	/	/	/	/		/		/	/		/	/		/		/	/	/	/	/	/					/				/			
W	Manorh	198	M	AA	/	/	/	/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	X	X	/	/	/	/
W	Manorh	127	M	MA										/	/							/	/	/	/	/	/	/	/			/	/	/	/	/	/
W	Manorh	71	M	AA	/	/	/	/		/						/	/		/	/	/	/	/	/	/	/	/	/	/	/		X	/	/	/	/	/
W	Manorh	151	M	AA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	62	M	AA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	102	M	OA	/	/	/	/		/		/		X	/	/	/	/	/	/	/	/	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	231	M	OA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	X	/	/	/
W	Manorh	251	M	MA	/	/	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/	/	/	/	/
W	Manorh	259	M	MA	/	/	/	/		/			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	7	M	AA	/	/	/	/	/	/	/	/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/
W	Manorh	215	M	AA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Manorh	57	M	AA	/	/	/	/								/	/	/		/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/	/
W	Manorh	227	M	AA	/	/	/	/		/					/		/		/	/	/	/	/	/	/	/		/	/		/	/	/	/	/	/	
W	Cashel	13	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Cashel	15	M	MA	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/
W	Cashel	4	M	MA	/	/	/	/	/	/	/	/	/	/	X	/	/	/	/	/	/	/	/	X	/	/	/	/	/	/	/	X	/	/	/	/	/
W	Cashel	27	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/
W	Cashel	32	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/
W	Cashel	3	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/
W	Cashel	10	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	X	X	/	/	/	/
W	Cashel	14	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	X	X	X	X	/	/

W	Cashel	47	M	MA	/	/	/	/	/	/	X	/	/	X	X	/	/	X	X	/	X	/	X	X	X	X	/	X	X	/	/	X	X	X	X	/	X
W	Cashel	11a	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
W	Cashel	29	M	OA	/	/	/	/	/	/		/	/	/		/	/	/	/	/		/		/		/		/									
W	Cashel	30	M	OA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/	X	/	/	X	/	X	/	/	/
M	John's Lane	2	F	OA							/			/	/						/	/	/	/		/	/	/	/			/	/	/	/		
M	John's Lane	20	F	MA					/	/	/	/		/				/		/		/		/		/	/	/	/	/	/	/	/	/	/		
M	John's Lane	16	F	MA	/	/	/	/		/		/	/	/	/	/	/	/	/		/		/				/										
M	John's Lane	7	F	AA																										/	/	/	/	/	/	/	/
M	Church St	289	F	AA			/	/	/	/		/	/			/	/	/	/		/																
M	Church St	285	F	YA				/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/										
M	St Fachtna's	10	F	MA						/	/			/	/							/	/	/	/	/	/	/	/		/		/		/		
M	St Fachtna's	8	F	AA						/			/	/	/				/							/	/	/	/	/			/				
M	St Fachtna's	7	F	AA																												/	/	/	/		
M	St Mary's	28	F	MA						/	/			/	/							/	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/
M	St Mary's	24	F	YA	X	/	/	/																													
M	John's Lane	1	M	AA																								/	/		/	/	/	/	/	/	/
M	John's Lane	21	M	AA																												/		/	/	/	/
M	John's Lane	22	M	AA																												/	/	/	/	/	/
M	John's Lane	24	M	AA																												/	/	/	/	/	/
M	John's	28	M	M										/														/	/	/	/	/	/	/	/	/	/

	Lane			A																																	
M	John's Lane	19	M	OA	/	/	X	/	/	/		/	/			/	/	/	/	/	/												/			/	
M	John's Lane	11	M	MA	/	/	/	/	/	/		/	/			/	/	/	/		/																
M	John's Lane	14	M	AA	/	/	/	/		/							/																				
M	John's Lane	10	M	AA																													/		/		/
M	John's Lane	3	M	AA					/	/	/		/	/					/																		
M	Church St	276	M	YA						/			/			/					/																
M	Church St	293	M	AA								/	/			/	/	/	/	/	/		/														
M	Church St	301	M	AA								/				/		/		/																	
M	St Fachtna's	12	M	AA																												/	/	/	/	/	/
M	St Fachtna's	13	M	AA										/	/								/		/	/	/	/	/	/	/	/	/				
M	St Fachtna's	9	M	MA						/	/			/	/					/		/		/		/	/	/	/								
M	St Fachtna's	11	M	MA						/	/			/	/					/	/	/	/	/	/	/	/	/	/	/		/					
M	St Fachtna's	2	M	MA						/	/									/	/	/	/	/	/	/	/	/	/								
M	St Mary's	31	M	MA	/	/					/			/	/							/	/	/	/	/						/	/				
M	St Mary's	23	M	OA	/	/	X	X	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	X	/	/
M	St Mary's	20	M	OA	/	/		/		/		/	/	/			/	/		/		/		/													
M	St Mary's	13	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								

M	St Mary's	10	M	MA	/	/	X	/		/	/	/	/	/	/	/	/	/	/		/		/		/	/	/	/	/	/	/	/	/	/	/	/	/
M	St Mary's	4	M	MA										/								/		/	/	/	/	/				/					
M	St Mary's	2	M	MA	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/	/	X	/	/	/	/	/
M	Church St	297	?	AA					/	/		/	/																								
M	St Fachtna's	3	?	AA																																/	/
M	St Fachtna's	1	?	AA									/				/		/		/	/		/												X	X
M	St Fachtna's	5	?	AA																								/	/								
M	St Fachtna's	4	?	AA																								/	/								
M	St Fachtna's	6	?	AA																												/	/				
M	St Mary's	15b	?	AA																								/	/	/	/						
U	St Anne's	9	F	YA																								/	/	/	/	/	/	/	/	/	/
U	St Anne's	79	F	YA						/	/	/	/		/		/		/	/	/	/	/	/	/	/	/	/	/								
U	St Anne's	114	F	YA	/	/	/	/	/	/		/	/			/	/	/	/	/	/		/		/												
U	St Anne's	148	F	YA																								/	/			/	/	/	/		
U	St Anne's	206	F	YA						/	/	X	X	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	X	X
U	St Anne's	1	F	MA	/	/	/	/	/	/	/	/	/	/	/		/		/		/		/		/		/		/		/	/	/	/	/	/	/
U	St Anne's	4	F	MA	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/		/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	25	F	MA					/	/	/	/	/	/	/		/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/

U	St Anne's	37	F	MA	/	/	/	/	/	/	/	/	/	/	/		/		/		/		/		/	/	/	/	/		/	/	/	/	/	/	/
U	St Anne's	40	F	MA				/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		
U	St Anne's	48	F	MA				/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/	/
U	St Anne's	53	F	MA	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	X	X	/	X	/	/
U	St Anne's	56	F	MA					/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	57	F	MA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/	/	/				X		/		/
U	St Anne's	61	F	MA	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/
U	St Anne's	70	F	MA	/	/	/	/	/	/	/	X	/	/	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/		/	X	/	X	/	/
U	St Anne's	81	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/
U	St Anne's	97	F	MA								/		/		/		/		/		/				/		/		/		/		/			
U	St Anne's	118	F	MA	/	/								/	/						/				/		/	/	/			/	/				
U	St Anne's	140	F	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/									
U	St Anne's	159	F	MA							/			/	/											/	/	/	/		/	/	/	/	/		/
U	St Anne's	172	F	MA	/	/	X	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	X	X	/	/	/	/
U	St Anne's	179	F	MA	/	/		/	/	/	/	/	/	/		/	/	/	/	/	/	/		/		/		/	/			/	/	/	/	/	/
U	St Anne's	236	F	MA						/	/		/	/	/		/		/	/	/	/	/	/	/	/	/	X	X	/	/	X	X	/	/	/	/
U	St Anne's	259	F	MA						/	/	/	/	/	/	/	/	/	/	/								/				/					
U	St Anne's	27	F	OA	/	/	/	/	/	/		X	/	/	/	/	/	/	/	/	/	/	/	/	/			/	/	/	/	/	/	/	/	/	/
U	St Anne's	34	F	OA	/	/	/	/		/		/	/			/	/	/	/		/																
U	St Anne's	44	F	OA						/				/	/								/		/	/	/	/	/	/	/	/	/	/	/	/	/

U	St Anne's	50	F	OA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	66	F	OA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/
U	St Anne's	72	F	OA	/	/	X			/			/	/		/	/									/	/	/	/	/		/	/	/	/	/	/
U	St Anne's	75	F	OA	/	/	/	/	/	/	/	/	/			/	/	/	/	/	/	/	/		/												
U	St Anne's	78	F	OA					/	/		/	/	/	/		/					/		/		/	/	/	/								
U	St Anne's	80	F	OA	/	/					/				/	/	/	/	/	/	/	/	/	/	/				/								
U	St Anne's	116	F	OA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/		/				/	/	/								
U	St Anne's	126	F	OA	/	/	/	/	/	/	/		X	/	/	/	/	/	/	/		/	/	/	/	/	/	/	/								
U	St Anne's	147	F	OA	/	/	/	/		/	/		/		/		/			/	/		/		/												
U	St Anne's	171	F	OA	/	/	X	/	/	/	/	/	/	/	/		/		/		/				/			/	/		/	/	/	/	/		/
U	St Anne's	181	F	OA	/	/		/		/		/	/		/		/		/		/		/						/								
U	St Anne's	246	F	OA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	7	F	AA	/	/	/	/		/		/	/			/	/	/	/																		
U	St Anne's	8	F	AA	/	/	/	/		/			X	/	/		/	/	/	/	/	/	/	/				/	/		/	X	/	/	/	/	/
U	St Anne's	20	F	AA					/	/		/	/			/		/																			
U	St Anne's	23	F	AA	/	/	/		/	/		/	/			/			/	/												X					
U	St Anne's	38	F	AA	/	/	/	/		/			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/			X	X	X	X	/	/
U	St Anne's	62	F	AA						/				/	/	/		/		/		/		/		/		/	/		/		/		/		
U	St Anne's	63	F	AA	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	76	F	AA					/	/		/	/	/	/		/	/	/		/	/	/	/	/		/										

U	St Anne's	82	F	AA	/	/	/	/	/	/		/	/				/	/	/		/				/			/	/	/	/	/	/				/
U	St Anne's	87	F	AA	/	/	/	/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/			/		/			
U	St Anne's	96	F	AA	/	/	/	/		/				/					/			/		/		/		/									
U	St Anne's	99	F	AA	/	/	/	/													/		/		/		/										
U	St Anne's	100	F	AA	/	/		/		/				/	/	/		/	/	/	/		/		/		/	/	/								
U	St Anne's	101	F	AA						/	/	/		/	/	/		/	/	/	/	/	/	/	/			/	/			/	/				
U	St Anne's	102	F	AA					/	/		/	/	/	/	/	/			/		/				/		/	/			/	/	/	/		
U	St Anne's	103	F	AA						/			X									/		/				/	/			/	/	/	/	/	/
U	St Anne's	110	F	AA																								/	/	/	/	X	X	/	/	/	/
U	St Anne's	112	F	AA																								/	X			X	X	X	X	/	/
U	St Anne's	119	F	AA										/	/													/	/	/	/	/	/	/	/	/	/
U	St Anne's	125	F	AA	/	/	/	/						/	/	/	/				/							/	/				/		/	/	/
U	St Anne's	128	F	AA						/	/			/	/													/	/			/	/	/	/	/	
U	St Anne's	133	F	AA	/	/	/	/		/			/	/	/		/		/	/	/	/	/	/	/		/	/	/		/		/		/		/
U	St Anne's	143	F	AA										/	/										/		/	/	/			/	/	/	/		
U	St Anne's	145	F	AA	/	/		/		/												/	/	/	/	/											
U	St Anne's	158	F	AA																								/	/								
U	St Anne's	160	F	AA										/	/											/	/	/	/		/	/	/	/	/	/	/
U	St Anne's	163	F	AA	/	/	/	/				/								/	/	/															
U	St Anne's	165	F	AA																								/	/			/	/	/	/	/	

U	St Anne's	175	F	AA																												/	/				
U	St Anne's	178	F	AA																									/			/	/	/	/		
U	St Anne's	180	F	AA																/		/		/		/		/				/					
U	St Anne's	188	F	AA										/	/													/	X			X	X			/	/
U	St Anne's	190	F	AA									/						/		/		/		/												
U	St Anne's	193	F	AA					/	/	/	/	/	/	/		/		/	/	/	X		/		/		/	/	/		/	/	/	/	/	/
U	St Anne's	197	F	AA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/				/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	218	F	AA										/	/												/	/	/			/	X				
U	St Anne's	228	F	AA						/	/			/	/		/		/	/	/		X		/	/	/	X	X	/	/	X	X	/	/	/	/
U	St Anne's	229	F	AA	/	/	/	/		/	/	X	/	/	/				/	/	/	/	/	/	/	/	/	/	/	/		X	X	/	/	/	/
U	St Anne's	243	F	AA																												X	X	/	/	/	/
U	St Anne's	244	F	AA						/					/								/		/		/		/				/		/	/	/
U	St Anne's	248	F	AA	/	/	/	/		/								/		/		/		/				/				X					
U	St Anne's	252	F	AA	/	/	/	/		/			/	/	/		/		/		/								/								
U	St Anne's	253	F	AA																												/	/	/	/	/	/
U	St Anne's	254	F	AA																	/			/			/					X	X	X	X	/	/
U	St Anne's	269	F	AA						/		/	/				/	/	/	/	/				/												
U	St Anne's	270	F	AA																	/		/														
U	St Anne's	274	F	AA																									/				/		/		
U	St Anne's	13	M	YA	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	X	X	X	X	X	X	/	/	X		/	/	X	X	X	X	X	X

U	St Anne's	14	M	YA	X	/	/	X	/	/	/	X	X	/	/	X	X	/	/	/	/	X	X	X	X	/	/	X	X	/	/	X	X	X	X		
U	St Anne's	18	M	YA	/	/			/	/	/	/	/	/	/													/									
U	St Anne's	21	M	YA			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/		/		X	X	/	/	X	X	/	/	/	/
U	St Anne's	22	M	YA	X	/	/	/	/	/	/	X	X	/		X		/	/	X	/	X	/	X		/		X		/	/	X	X	X	X	/	/
U	St Anne's	59	M	YA	/	/	/	/		/		X	X				/		/																		
U	St Anne's	92	M	YA	/	/	/	/	/	/		/	/			/	/	/	/	/	/																
U	St Anne's	122	M	YA					/	/		/	/			/	/	/	/	/	/		/		/												
U	St Anne's	132	M	YA	/	/	/	/	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	137	M	YA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/		/	/	/		/										
U	St Anne's	139	M	YA						/	/			/	/							/				/		/	/								
U	St Anne's	207	M	YA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/			/	/				
U	St Anne's	230	M	YA	/	/	/	/		/		/		/	/	/	/	/	/	/	/	/	/	/	/			/	/			/	/	/	/	/	/
U	St Anne's	235	M	YA	/	/				/	/	X	/	/	/	/	/	/	/	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	/
U	St Anne's	239	M	YA									/	/	X						/		/		/		/		/								
U	St Anne's	261	M	YA					/	/		/				/		/		/		/		/													
U	St Anne's	2	M	MA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	10	M	MA	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	15	M	MA	/	/			/	/	/	/	/	/	/		/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X
U	St Anne's	16	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	19	M	MA						/	/		/	/	/							/	/	/	/	/	/	/	/		/	/	/	/	/	/	/

U	St Anne's	28	M	MA	/	/	/	/	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	X	X	X	X	X	/
U	St Anne's	32	M	MA	X	/	X	/	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	X	/	/	/
U	St Anne's	33	M	MA					/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	35	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/	/	/	X	/	/	/	/
U	St Anne's	46	M	MA	X	/	/	/	/	/	/	X	X	/	/	/				/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	51	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	55	M	MA					/	/	/	X		/	/					/	/	X	X	/	/	/	/	X	X	/	/	X	X	/	/	X	X
U	St Anne's	60	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/
U	St Anne's	71	M	MA	/	/	/	/	/	/	/	X	X	/	/	/	/	X	/	X	X	X	X	X	X	/	/	X	X	/	/	X	X	X	X	X	X
U	St Anne's	115	M	MA	/	/	/	/		/	/	X	/	/	/			/	/	X	X	X	X	/	X		/		/								
U	St Anne's	123	M	MA	/	/	/	/	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/						
U	St Anne's	131	M	MA						/	/			/	/							/				/		/	/	/	/	/	/	/	/	/	/
U	St Anne's	146	M	MA	/	/	/	/	/	/	/	/	X		/		/		/		/		/		/		/		X		/						
U	St Anne's	155	M	MA	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/								
U	St Anne's	162	M	MA	/	/	/	/	/	/	/	X	/	/	/	X	/	/	/	/	/	/	/	/	/	/	/	/	/								
U	St Anne's	183	M	MA	/	/	/	/	/	/	/	/	X	X	X	/		/	/	/	/		/	/	/	/	X	X	X			X	X	X	X	/	X
U	St Anne's	184	M	MA					/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/	/	/				/	/		
U	St Anne's	194	M	MA							/		X	/	/					/		/		/				X				X		X		X	X
U	St Anne's	196	M	MA	/	/	/	/		/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/	/	X	X	/	/	/	/
U	St Anne's	210	M	MA					/	/	/	X	X	/	/		/		/	X	X	X	X	X	X	X	/	X	X	/	/	X	X	X	X	X	X

U	St Anne's	221	M	MA	/	/	/	/		/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/			/	/		
U	St Anne's	223	M	MA							/			/	/								/		/	/	X	/	X	/	/						
U	St Anne's	241	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	/	/	/	/	/	/	/		/	X	X	/	/	/	/
U	St Anne's	251	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	258	M	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/										
U	St Anne's	267	M	MA					/	/	/	X	/	/	/	/		/		/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	280	M	MA	/	/	/	/	/	/	/	/				/		/	/	/	/	/	/	/	/	/	/	/	/								
U	St Anne's	281	M	MA	/	/	/	/		/	/					/		/	/	/	/	/	/	/	/	/	/										
U	St Anne's	24	M	OA	/	/			/	/		/	/	/		/		/		/		/		/		/		/						/			
U	St Anne's	43	M	OA	/	/	/			/	/			/	/			/		/	/	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	54	M	OA	/	/		/		/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	X	X	X	X	/	/
U	St Anne's	88	M	OA	/	/			/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/			/	/				
U	St Anne's	127	M	OA						/	/	/	/	/	/					/	/	/	/	/	/	/	/	/	/								
U	St Anne's	150	M	OA				/	/	/	/	/	X	/	/	/		/	/	/		/		/	/	/	/	/	/	/		/	/	/		/	
U	St Anne's	173	M	OA				/	/	/	/	/	X	/	/	/		/	/	/	/		/		/			X	X	/	/	X	X	X	X	/	/
U	St Anne's	192	M	OA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	238	M	OA						/	/			/	/							/	/	/	/	/	/	/	/			/	/	/	/		
U	St Anne's	12	M	AA						/	/	/	/	/	/		/		/		/	/	/		/	/	/	/	/		/	/	/	/	/	/	/
U	St Anne's	86	M	AA										/	/											/	/	/	/	/	/	X	X				/
U	St Anne's	90	M	AA																												X	X	/	/	/	/

U	St Anne's	91	M	AA																								/	/	/	/	X	X	/	/	/	/
U	St Anne's	95	M	AA					/	/		/	/			/		/		/		/		/													
U	St Anne's	98	M	AA	/	/	/			/	/			/	/													/	/			/	/	/	/	/	/
U	St Anne's	111	M	AA																									/				/		/		
U	St Anne's	117	M	AA	/	/															/												/				
U	St Anne's	120	M	AA	/	/	/	/												/								/	/	/	/	X	X	/	/	/	/
U	St Anne's	130	M	AA						/		/	/	/	/	/	/	/		/	/	/	/		/	/		/	/			/	/	/	/	/	/
U	St Anne's	134	M	AA	/	/	/	/								/	/					/															
U	St Anne's	149	M	AA	/	/	/	/	/	/	/	/		/	/	/		/						/		/		/			/		/				
U	St Anne's	151	M	AA											/						/		/						/			X					
U	St Anne's	152	M	AA	/	/	/	/		/			/	/	/		/	/	/	/	/	/	/	/	/	/		/	/								
U	St Anne's	153	M	AA	/	/	/	/		/				/		/		/		/		/		/		/		/									
U	St Anne's	154	M	AA	/	/	/	/		/			/	/	/	/	/	/	/	/	/	/	/	/	/	/		X	X	/	/	/	/	/	/	/	/
U	St Anne's	156	M	AA				/		/	/																	/	/	/			/				/
U	St Anne's	157	M	AA																								/					X		/		
U	St Anne's	164	M	AA						/				/				/		/		X		X		X		/									
U	St Anne's	167	M	AA	/	/	/	/		/						/	/	/	/	/	/																
U	St Anne's	177	M	AA	X	/	/	/		/										/																	
U	St Anne's	182	M	AA																/		/		/				X				X		X		X	X
U	St Anne's	186	M	AA																												/	/	/	/	/	/

U	St Anne's	195	M	AA										/	/										/	/	/	/	/		/	/	/	/	/	/	
U	St Anne's	200	M	AA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/		/						/	/	/			/	/				
U	St Anne's	201	M	AA	/	/	/	/		/		/	/			/	/	/	/	/	/																
U	St Anne's	202	M	AA	/	/											/	/	/	/	/																
U	St Anne's	203	M	AA					/			/								/																	
U	St Anne's	204	M	AA	/	/	/	/		/		/	/			/	/	/	/	/	/	/	/														
U	St Anne's	205	M	AA	/	/	/	/	/	/		/	/				/		/		/																
U	St Anne's	209	M	AA						/				/													/	X	X			/	/	/	/	/	/
U	St Anne's	215	M	AA										/	/				/		/	/	/	/	/		/	/	/	/		/	/	/	/	/	/
U	St Anne's	219	M	AA						/				/	/							/	/	/	/	/		/	/			/	/	/	/		
U	St Anne's	220	M	AA	/	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/	/	/	/	/	/	X	X			X	X	X	X	X	X
U	St Anne's	222	M	AA						/				/	/							/		/	/			X	/			/	/	/	/	/	/
U	St Anne's	226	M	AA																												X	X	/	/	/	/
U	St Anne's	231	M	AA	/	/	/	/	/	/		/	/			/	/		/	/	/																
U	St Anne's	232	M	AA	/	/	/	/	/	/		/	/			/	/		/	/	/																
U	St Anne's	240	M	AA						/				/	/										/		/	/	/		/						
U	St Anne's	242	M	AA						/	/			/	/							/	/	/	/	/		/	/	/	/	/	/	/	/	/	/
U	St Anne's	247	M	AA	X	/	/	/	/	/		/	X			/	/	/	/		/																
U	St Anne's	264	M	AA																								X		/		X		/		/	/
U	St Anne's	279	M	AA	/	/	/	/		/		/	/		/	/	/	/	/		/		/		/		/	/	/								

U	St Anne's	39	?	YA					/	/		X	/			/	/	/	/	/			/	/													
U	St Anne's	17	?	YA	/	/	/	/		/		/	/			X	/	/	/	/																	
U	St Anne's	233	?	AA	/	/	/	/		/			/		/						/								/				/				
U	St Anne's	107	?	MA	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
U	St Anne's	5	?	AA											/							/		/		/		/	/			/	X		/		
U	St Anne's	64	?	AA				/		/	/		/	/	/			/	/	/	/	/	/	/	/	/	/	X	/	/	/	/	/				
U	St Anne's	67	?	AA																												X	/	/	/		
U	St Anne's	68	?	AA								/				/		/																			
U	St Anne's	69	?	AA																												/	/	/	/		
U	St Anne's	73	?	AA	/	/		/		/		/	/			/	/	/	/	/	/					/	/	/				X		/			
U	St Anne's	77	?	AA					/	/		/	/								/	/		/			/										
U	St Anne's	84	?	AA										/														/		/		X	X		/	/	/
U	St Anne's	85	?	AA																			/		/		/	/	/		/	/	/	/	/	/	/
U	St Anne's	89	?	AA																												/	/	/	/		
U	St Anne's	109	?	AA										/											/		/	/				/					
U	St Anne's	138	?	AA	/	/	/	/																				/	/			/	/			/	/
U	St Anne's	168	?	AA				/		/	/	/			/	/				/		/							/				/				
U	St Anne's	169	?	AA	/	/	/	/	/	/		/	/						/																		
U	St Anne's	170	?	AA				/		/		/	/			/	/	/	/	/																	
U	St Anne's	198	?	AA																								/				/		/		/	

U	St Anne's	199	?	AA	/	/	/			/				/		/												/					X				
U	St Anne's	208	?	AA						/		/				/		/		/	/	/		/													
U	St Anne's	212	?	AA																/	/																
U	St Anne's	213	?	AA						/			/						/																		
U	St Anne's	214	?	AA						/				/	/				/				X		X			/	X			X	X	X	X	/	X
U	St Anne's	217	?	AA										/						/	/	/		/													
U	St Anne's	224	?	AA	/	/	/	/	/	/		/	/			/	/	/	/		/																
U	St Anne's	225	?	AA									/			/	/	/	/	/	/																
U	St Anne's	227	?	AA					/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/												
U	St Anne's	234	?	AA																			/						/				/				/
U	St Anne's	237	?	AA																								/	/			/	/				
U	St Anne's	245	?	AA											/													/	/								
U	St Anne's	249	?	AA																												/	/	/	/	/	/
U	St Anne's	250	?	AA																	/	/	/	/	/	/	/	/	/	/		/	/	/	/	/	/
U	St Anne's	255	?	AA																															/	/	/
U	St Anne's	268	?	AA						/		X	/																								
U	St Anne's	276	?	AA																											/	X	X	X	X	/	/

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